# HUMAN BIOLOGY

## a record of research

DECEMBER, 1954

UNIVERSITY OF MICHIGAN
FEB 8 1955
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Vol. 26 No. 4

PUBLISHED QUARTERLY BY
WAYNE UNIVERSITY PRESS, DETROIT 1, MICHIGAN, U.S.A.

# HUMAN BIOLOGY

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Subscribers should notify the publishers of change in address at least two weeks before publication of the issue with which the change is to take effect. No claim for non-receipt of an issue will be entertained unless made immediately upon receipt of the next succeeding issue.

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WAYNE UNIVERSITY PRESS, *Publishers*

4841 Cass Avenue

DETROIT 1, MICHIGAN, U. S. A.

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HUMAN BIOLOGY
a record of research

DECEMBER, 1954

VOL. 26 No. 4

# THE INTERPUPILLARY DISTANCE IN MENTALLY DEFECTIVE PATIENTS

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## INTRODUCTION

THE interpupillary distance is a measurement which has been widely used in physical anthropology. It shows considerable variation in different populations; the eyes of Africans are more widely spaced than those of Europeans, for example. The measurement is likely also to be of clinical interest because, among defectives, a large number of characteristic skull shapes occurs and the position of the eyes is often influenced. No systematic investigation of the interpupillary distance in defectives seems to have been undertaken hitherto. The present paper is intended as a contribution to the method of basing diagnosis upon exact measurement rather than on clinical impression.

## SUMMARY OF PREVIOUS LITERATURE

The interpupillary distance has been mainly studied in hypertelorism and mongolism. Barr ('04) noted the proximity of the eyes in mongolism and Brushfield ('24), on the basis of actual measurement, reached the same conclusion. Van der Scheer ('27) also noted that this distance is reduced in mongolism. Lowe ('49) found that the eyes of mongols were about 5 mm closer together than in normal adults though this fact had to be considered in relation to the small size of their heads and reduction of their measurements generally.

Kanner ('35), describing mongolism, states: "The eyes are very near each other, though the flat bridge of the nose may give the impression that they are spaced more widely." This impression has led many people astray; for example, Wilson ('40) says that the eyes are set obliquely and wide apart. Øster ('53) quotes observers, such as Weygandt, who also had stated that the distance was increased. Carter and McCarthy ('51) are not clear on this point and Engler ('49) was unable to find any divergence from the normal. Draper, Dupertuis and Caughey ('44) describe wide set eyes as a feature closely related to mongolism.

Greig ('24), for hypertelorism, observed that one of the most characteristic features was increased distance between the eyes.

## MATERIAL AND METHODS IN THE PRESENT STUDY

Patients measured for this survey were resident in Heckingham Institution, Little Plumstead Hall and Eaton Grange Hostel for Girls, Norfolk, or at Cell Barnes Hospital, Hertfordshire. Measurements of one mentally defective case of hypertelorism (at St. Lawrence's Hospital Caterham, Surrey) were kindly supplied by Dr. B. W. Richards. The writers are indebted to Dr. J. V. Morris and Dr. N. H. M. Burke for granting facilities for measuring the patients under their care.

The control group (for interpupillary distance) comprised 100 adult males and 100 adult females whose measurements were supplied by courtesy of Messrs. Clement Clarke of St. Albans: these measurements were taken for the purpose of fitting spectacles. One mentally normal case of hypertelorism, an adult male, was recorded in the data.

The measurement of the interpupillary distance was taken by the standard method. This consists in reading the distance, in millimeters, between the centers of the pupils on a transparent scale held at arm's length horizontally across the bridge of the subject's nose. The subject

is required to direct first one eye and then the other towards the opposite eye of the investigator. Thus readings are made as though the visual axes were parallel. Only those cases in which satisfactory cooperation could be obtained were used in this survey. If strabismus is present, the eye of the patient which is not being observed must be occluded.

In order to make a systematic analysis of the relationships between head size and interpupillary distance, and the changes involved with age, head length and head breadth were measured by standard anthropological methods for all patients in the survey. Head measurements of mentally normal controls were obtained from a sample of 192 male and 101 female adults, which included members of institution staffs, for comparison with an adult defective population.

The diagnoses and grades used in the tables (see also the key to tables 1 and 2), were checked by one of us (L. A. K.) who also measured all the defectives used in the survey.

## RESULTS

Since normal control measurements were available for these three measurements only in adult subjects, the main investigation covered 396 male and 302 female defectives aged 15 years and over. Even this grouping is not quite satisfactory since the head continues to grow after the age of 15 years. The results, by diagnosis and grade, are shown in tables 1 and 2. Measurements made on patients below the age of 15 years are summarized here and they show how all the measurements gradually increase with age. Unfortunately there are no normal controls available for comparison with them.

### KEY TO TABLES 1 AND 2

*Diagnosis*

| | | | | | |
|---|---|---|---|---|---|
| 1 | Mongolism | 6 | Endocrine | 11 | Epilepsy |
| 2 | Microcephaly | 7 | Hemiplegia | 12 | Psychosis |
| 3 | Acrocephaly | 8 | Diplegia | 13 | Miscellaneous (epiloia, phenylketonuria, microphthalmos) |
| 4 | Hydrocephaly | 9 | Athetosis | 14 | Hypertelorism |
| 5 | Skeletal (other) | 10 | Neurological (other) | 15 | Residual group |

*Grade*

| | | | | | |
|---|---|---|---|---|---|
| 1 | Idiot | 2 | Imbecile | 3 | Feeble-minded |

TABLE 1

*Head measurements of defectives and controls: males*

| Age | Diagnosis | Grade 1 | Grade 2 | Grade 3 | Interpupillary distance 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | No. of Cases | Mean measurements I. d.* | H. b.† | H. l.† | I. d.÷ H. b. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–4 | All | 4 | 6 | 0 | 1 | 2 | 4 | 1 | 2 | . | . | . | 10 | 47.5 | 131.0 | 158.5 | 0.36 |
| 5–9 | All | 19 | 20 | 4 | . | . | 4 | 24 | 11 | 4 | . | . | 43 | 53.6 | 135.9 | 167.7 | 0.39 |
| 10–14 | All | 13 | 30 | 6 | . | . | . | 10 | 27 | 12 | . | . | 49 | 57.0 | 141.0 | 174.6 | 0.40 |
| 15+ | 1 | 0 | 17 | 0 | . | . | 1 | 8 | 7 | 1 | . | . | 17 | 54.6 | 142.6 | 172.3 | 0.38 |
| | 2 | 2 | 2 | 0 | . | . | . | . | 1 | 3 | . | . | 4 | 60.0 | 123.2 | 173.2 | 0.49 |
| | 3 | 2 | 2 | 0 | . | . | . | 1 | . | 1 | 2 | . | 4 | 62.8 | 149.5 | 183.2 | 0.42 |
| | 4 | 3 | 1 | 0 | . | . | . | 2 | 1 | 1 | . | . | 4 | 55.5 | 159.5 | 198.2 | 0.35 |
| | 5 | 0 | 7 | 0 | . | . | . | . | 1 | 6 | . | . | 7 | 61.7 | 144.9 | 186.3 | 0.43 |
| | 6 | 3 | 4 | 3 | . | . | . | 2 | 2 | 2 | 3 | 1 | 10 | 60.4 | 142.0 | 184.5 | 0.42 |
| | 7 | 1 | 9 | 3 | . | . | . | . | 5 | 3 | 5 | . | 13 | 62.4 | 141.2 | 183.5 | 0.44 |
| | 8 | 9 | 10 | 2 | . | . | . | . | 5 | 13 | 2 | 1 | 21 | 61.5 | 139.1 | 181.0 | 0.44 |
| | 9 | 0 | 4 | 2 | . | . | . | . | 1 | 3 | 2 | . | 6 | 62.8 | 147.0 | 188.7 | 0.43 |
| | 10 | 5 | 22 | 15 | . | . | . | 2 | 10 | 22 | 7 | 1 | 42 | 61.4 | 145.0 | 188.8 | 0.42 |
| | 11 | 7 | 14 | 18 | . | . | . | 1 | 7 | 19 | 9 | 3 | 39 | 62.3 | 147.3 | 189.6 | 0.42 |
| | 12 | 7 | 18 | 18 | . | . | . | 1 | 6 | 24 | 11 | 1 | 43 | 62.3 | 147.7 | 186.5 | 0.42 |
| | 13 | 2 | 3 | 1 | . | . | . | . | 2 | 4 | . | . | 6 | 59.8 | 142.8 | 180.3 | 0.42 |
| | 14 | 0 | 1 | 0 | . | . | . | . | . | . | 1 | . | 1 | 67.0 | 148.0 | 178.0 | 0.45 |
| | 15 | 9 | 57 | 113 | . | . | . | 7 | 50 | 98 | 23 | 1 | 179 | 60.7 | 145.4 | 185.7 | 0.42 |
| 15+ | All | 50 | 171 | 175 | . | . | 1 | 24 | 98 | 200 | 65 | 8 | 396 | 61.0 | 145.0 | 185.5 | 0.42 |
| 15+ | Control measurements | | | | . | . | . | . | 7 | 54 | 31 | 8 | 100 | 64.3 | 151.5 | 194.6 | 0.42 |
| | S. D. | | | | | | | | | | | | | 3.3 | 6.0 | 6.7 | — |

* I. d., interpupillary distance; the mean is based on ungrouped data.
† H. b., head breadth; H. l., head length.

TABLE 2

† H. b., head breadth; H. l., head length.

TABLE 2

*Head measurements of defectives and controls: females*

| Age | Diagnosis | Grade 1 | Grade 2 | Grade 3 | Interpupillary distance 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | No. of Cases | Mean measurements I. d.* | H. b.† | H. l.† | I. d.÷ H. b. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–4 | All | 5 | 2 | 1 | 1 | . | 3 | 4 | . | . | . | . | 8 | 48.2 | 125.7 | 154.5 | 0.38 |
| 5–9 | All | 6 | 10 | 1 | . | . | 4 | 6 | 6 | 1 | . | . | 17 | 53.3 | 133.2 | 158.5 | 0.40 |
| 10–14 | All | 2 | 14 | 5 | . | . | 2 | 5 | 9 | 5 | . | . | 21 | 55.9 | 135.1 | 170.8 | 0.41 |
| 15+ | 1 | 0 | 16 | 0 | . | . | . | 4 | 12 | . | . | . | 16 | 55.4 | 140.4 | 162.3 | 0.39 |
| | 2 | 0 | 1 | 1 | . | . | . | 1 | 1 | . | . | . | 2 | 55.0 | 134.5 | 167.0 | 0.41 |
| | 3 | 0 | 2 | 0 | . | . | . | . | 2 | . | . | . | 2 | 56.0 | 147.0 | 177.0 | 0.38 |
| | 4 | 0 | 2 | 0 | . | . | . | . | . | 2 | . | . | 2 | 62.0 | 174.5 | 202.0 | 0.35 |
| | 5 | 0 | 14 | 5 | . | . | . | 3 | 10 | 5 | 1 | . | 19 | 58.6 | 139.1 | 180.7 | 0.42 |
| | 6 | 0 | 3 | 8 | . | . | . | . | 3 | 8 | . | . | 11 | 60.5 | 143.8 | 177.0 | 0.42 |
| | 7 | 0 | 3 | 2 | . | . | . | . | 1 | 2 | 2 | . | 5 | 61.8 | 137.0 | 177.0 | 0.45 |
| | 8 | 5 | 8 | 4 | . | . | . | 1 | 5 | 10 | 1 | . | 17 | 59.8 | 137.6 | 175.5 | 0.43 |
| | 9 | 1 | 3 | 3 | . | . | . | . | 3 | 3 | 1 | . | 7 | 60.4 | 139.1 | 180.6 | 0.43 |
| | 10 | 1 | 8 | 11 | . | . | . | 1 | 8 | 9 | 2 | . | 20 | 60.5 | 141.2 | 177.2 | 0.43 |
| | 11 | 3 | 14 | 15 | . | . | . | . | 10 | 19 | 2 | 1 | 32 | 61.2 | 141.5 | 178.2 | 0.43 |
| | 12 | 0 | 9 | 18 | . | . | . | 2 | 12 | 12 | 1 | . | 27 | 59.2 | 143.1 | 177.4 | 0.41 |
| | 13 | 0 | 2 | 1 | . | . | . | . | 2 | . | 1 | . | 3 | 60.0 | 133.7 | 170.3 | 0.45 |
| | 14 | 0 | 0 | 0 | . | . | . | . | . | . | . | . | 0 | — | — | — | — |
| | 15 | 2 | 46 | 91 | . | . | 1 | 6 | 61 | 58 | 13 | . | 139 | 59.5 | 142.0 | 178.0 | 0.42 |
| 15+ | All | 12 | 131 | 159 | . | . | 1 | 18 | 130 | 128 | 24 | 1 | 302 | 59.5 | 141.5 | 177.1 | 0.42 |
| 15+ | Control measurements | | | | . | . | . | 3 | 32 | 55 | 10 | . | 100 | 60.6 | 145.8 | 186.1 | 0.42 |
| | S. D. | | | | | | | | | | | | | 3.0 | 5.4 | 7.0 | — |

* I. d., interpupillary distance; the mean is based on ungrouped data.

† H. b., head breadth; H. l., head length.

The three measurements can be investigated in any clinical group of adult defectives. Outstanding examples are mongolism, microcephaly, hydrocephaly, and hypertelorism. In all, 4 cases of hypertelorism were examined; they are males of whom three are defective and one is of normal mentality. The measurements are as follows:

| Age | Grade | Interpupillary distance | Head breadth | Head length |
|---|---|---|---|---|
| 9 [1] | idiot | 63 | 127 | 163 |
| 15 [1,2] | imbecile | 67 | 148 | 178 |
| 22 [2] | imbecile | 78 | 158 | 202 |
| 49 | normal | 73 | 146 | 181 |

[1] See table 1. [2] See table 3.

Three of these cases are adults and their mean interpupillary distance measurement is 72.7, almost 2½ times S. D. (standard deviation) above the control mean of 64.3. Since adult Africans in Jamaica have a mean measurement of 70.6 (Davenport and Steggerda, '30) it is clear that hypertelorism is not necessarily an abnormal trait but is usually a variation on a graded scale. The value of 78, in the third case recorded above, must, however, be regarded as grossly abnormal for a European.

When all measurements are expressed in terms of standard deviations exact comparisons can be made, and the difference divided by the standard deviation is given in table 3 for the three measurements in the various outstanding types.

It is clear that in the mongols the length of the head is greatly diminished, —3½ S. D., and that the head breadth is only slightly less than the normal control; interpupillary distance is markedly, about —2 S.D., different from the normal. In the case of microcephaly, head length is diminished less than that of the mongols, head breadth is more diminished than that of the mongols; the interpupillary distance is small in these cases, as might be expected, but, in relation to head breadth, it is not diminished as it is in mongolism.

Hydrocephaly is associated with increased head length and, especially, breadth of the head but the interpupillary distance is not increased and may even sometimes be markedly diminished.

The interrelationships between these three head measurements are of biometric interest. In order to study them precisely, correlation coefficients were calculated on the total data, pooling all patients of different

TABLE 3

*Analysis of head measurements by clinical type (age 15 years and over)*

| Diagnosis | Number | Sex | Measurement | Mean | Difference from Control* (D) | (D) ÷ (S. D.)* |
|---|---|---|---|---|---|---|
| 1 Mongolism | 17 | m | Interpup. dist. | 64.3 | — 9.7 | —2.9 |
| | | | Head breadth | 142.6 | — 8.9 | —1.5 |
| | | | Head length | 172.3 | —22.3 | —3.3 |
| | 16 | f | Interpup. dist. | 55.4 | — 5.2 | —1.7 |
| | | | Head breadth | 140.4 | — 5.4 | —1.0 |
| | | | Head length | 162.3 | —23.8 | —3.4 |
| | 33 | m & f† | Interpup. dist. | | | —2.3 |
| | | | Head breadth | | | —1.3 |
| | | | Head length | | | —3.3 |
| 2 Microcephaly | 4 | m | Interpup. dist. | 60.0 | — 4.3 | —1.3 |
| | | | Head breadth | 123.2 | —28.3 | —4.7 |
| | | | Head length | 173.2 | —21.4 | —3.2 |
| | 2 | f | Interpup. dist. | 55.0 | — 5.6 | —1.3 |
| | | | Head breadth | 134.5 | —11.3 | —2.1 |
| | | | Head length | 167.0 | —19.1 | —2.7 |
| | 6 | m & f† | Interpup. dist. | | | —1.5 |
| | | | Head breadth | | | —3.8 |
| | | | Head length | | | —3.0 |
| 4 Hydrocephaly | 4 | m | Interpup. dist. | 55.5 | — 8.8 | —2.7 |
| | | | Head breadth | 159.5 | + 8.0 | +1.3 |
| | | | Head length | 198.2 | + 3.6 | +0.5 |
| | 2 | f | Interpup. dist. | 62.0 | + 1.4 | +0.5 |
| | | | Head breadth | 174.5 | +28.7 | +5.3 |
| | | | Head length | 202.0 | +15.9 | +2.3 |
| | 6 | m & f† | Interpup. dist. | | | —1.6 |
| | | | Head breadth | | | +2.6 |
| | | | Head length | | | +1.1 |
| 14 Hypertelorism | 3 | m | Interpup. dist. | 72.7 | + 8.4 | +2.5 |
| | | | Head breadth | 150.3 | — 1.2 | —0.2 |
| | | | Head length | 187.0 | — 7.6 | —1.1 |

* See tables 1 and 2.

† Weighted mean.

ages (see table 4). Naturally, there were positive correlations between age and each measurement and these had to be eliminated statistically. The degrees of association of the measurements for constant age were found by applying partial correlation technique. Interpupillary distance was shown to be closely related to head length. It was therefore concluded that, for clinical purposes, comparison of interpupillary distance with head breadth, rather than with length, would give the most useful information.

TABLE 4

*Correlation coefficients*

| Characters | Males (498 cases) | Females (348 cases) |
|---|---|---|
| Interpupillary distance and head breadth | $+0.493 \pm 0.034$ | $+0.450 \pm 0.043$ |
| " " and head length | $+0.660 \pm 0.025$ | $+0.598 \pm 0.034$ |
| " " and age | $+0.440 \pm 0.036$ | $+0.351 \pm 0.047$ |
| Head breadth and head length | $+0.570 \pm 0.030$ | $+0.493 \pm 0.041$ |
| " " " age | $+0.204 \pm 0.043$ | $+0.219 \pm 0.051$ |
| Head length and age | $+0.380 \pm 0.038$ | $+0.355 \pm 0.047$ |
| Interpupillary distance and head breadth, for constant age | $+0.459$ | $+0.408$ |
| Interpupillary distance and head length, for constant age | $+0.593$ | $+0.541$ |

A simple way of indicating the peculiarities observed, on the one hand in mongolism and, on the other, in hypertelorism, is to examine the index (interpupillary distance ÷ head breadth). This index has some advantage over the traditional one, obtained by dividing interpupillary distance by face breadth. The head breadth is available and known to be useful for clinical purposes whereas face breadth is not.

The index, interpupillary distance divided by head breadth, was found to vary between 0.30 and 0.51. There are no controls available directly for this index but the average value for normal European adults must be close to 0.42. The mean values of I. d. and H. b. ($m_a$ and $m_b$ respectively) for controls, given in tables 1 and 2, their S. D. values ($s_a$ and $s_b$ respectively) and the intercorrelation between these two measurements corrected for age ($r_{ab}$) can be used to estimate the normal value of the index (a/b) and its standard deviation ($s_{a/b}$). Thus,

$$(s_{a/b})^2 = (m_b^2 s_a^2 - 2m_a m_b s_a s_b r_{ab} + m_a^2 s_b^2)/b^4$$

Assuming that $m_{a/b} = m_a/m_b$, the index for control males has a mean of 0.420 with S. D. of 0.021 and the mean index for control females is 0.416 with S. D. of 0.020. Distributions derived from defectives and controls are summarized in table 5 and figure 1 has been constructed from table 6.

TABLE 5

*Mean interpupillary distance ratio (distance/head-breadth) in different sample populations*

| Description of cases | Age Group in years | Number | Mean Ratio | Standard Deviation |
|---|---|---|---|---|
| Mongolism | 0 to 14 | 30 | 0.385 | 0.019 |
| | 15 & over | 33 | 0.390 | 0.021 |
| Hypertelorism | all ages | 3 | 0.480 | 0.026 |
| Other types of defectives | 0 to 14 | 117 | 0.402 | 0.031 |
| | 15 & over | 664 | 0.423 | 0.029 |
| Control males | 15 & over | 100 | 0.420 | 0.021 |
| Control females | 15 & over | 100 | 0.416 | 0.020 |

TABLE 6

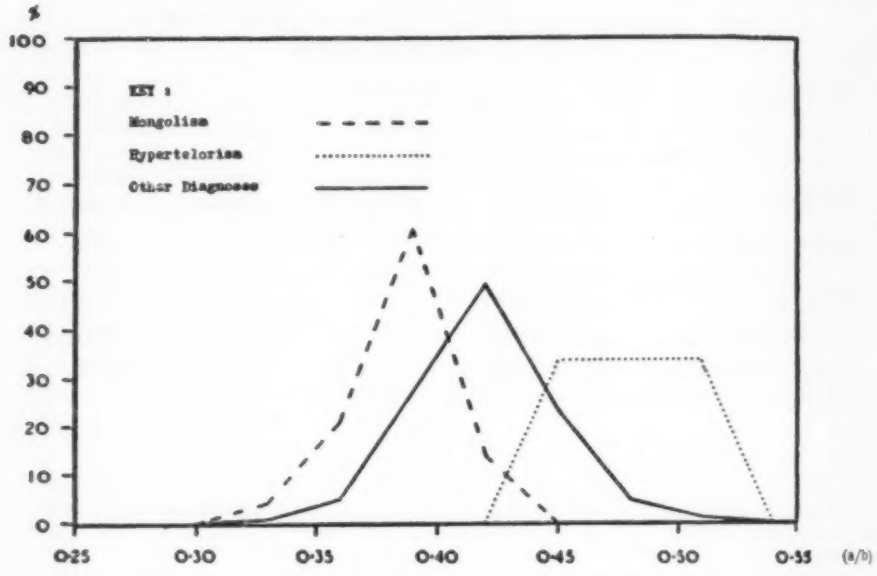
*Percentage distribution of interpupillary ratio in defectives*

| (a/b) * Ratio | Cases of Mongolism | Cases of Hypertelorism | All Other Cases |
|---|---|---|---|
| 0.50+ | 0.0 | 33.3 | 0.9 |
| 0.47–0.49 | 0.0 | 33.3 | 5.4 |
| 0.44–0.46 | 0.0 | 33.3 | 24.3 |
| 0.41–0.43 | 14.3 | 0.0 | 39.6 |
| 0.38–0.40 | 61.9 | 0.0 | 23.7 |
| 0.35–0.37 | 20.6 | 0.0 | 5.2 |
| 0.32–0.34 | 3.2 | 0.0 | 0.8 |
| –0.31 | 0.0 | 0.0 | 0.1 |
| Total | 100.0 | 99.9 | 100.0 |
| Number of cases | 63 | 3 | 781 |

* Interpupillary distance ÷ head breadth.

The average of this index, for all defectives, agrees with the control: it is slightly less than this in infants (see tables 1 and 2).

In mongols the average is between 0.38 and 0.39. As in many other characters the mongols show less variation than other defectives here. The standard deviation is just 0.02, instead of nearly 0.03 in the other cases. The index is also notably low in hydrocephaly.




Index (a/b) = (Interpupillary distance) ÷ (Head breadth)

FIG. 1. PERCENTAGE DISTRIBUTIONS OF MENTALLY DEFECTIVE PATIENTS (ALL AGES).

SUMMARY

Interpupillary distance has been measured in 498 male and 348 female defectives and related to head breadth and head length. Comparisons were made between the measurements of adult defective and normal adult controls.

It is found that the ratio of interpupillary distance to head breadth is a useful clinical index. This ratio, which has a normal value of 0.42, with a standard deviation of 0.02, is much greater in hypertelorism (0.48) and much less in mongolism (0.38).

## LITERATURE CITED

BARR, W. M. 1904 Mental Defectives, their History, Treatment and Training. Rebman Ltd., London.

BRUSHFIELD, T. 1924 Mongolism. Brit. J. Child. Dis., Lond., *21*:241-258.

CARTER, C. O. AND D. MCCARTHY 1951 Incidence of mongolism and its diagnosis in the newborn. Brit. J. Soc. Med., *5*: 83.

DAVENPORT, C. B. AND M. STEGGERDA 1930 Race Crossing in Jamaica. Carnegie Institute Publication, Washington.

DRAPER, G., C. W. DUPERTUIS AND J. L. CAUGHEY 1944 Human Constitution in Clinical Medicine. Paul B. Hoeber, New York.

ENGLER, M. 1949 Mongolism (Peristatic Amentia). Simpkin Marshall, Ltd., London.

GREIG, D. M. 1924 Hypertelorism: a hitherto undifferentiated congenital craniofacial deformity. Edinb. Med. J., n. s. *31*: 560-593.

KANNER, L. 1935 Child Psychiatry. Charles C. Thomas, Springfield.

LOWE, R. M. 1949 The eyes in mongolism. Brit J. Ophthalmol., *33*: 131-174.

ØSTER, J. 1953 Mongolism. Ejnar Munksgaard, Copenhagen.

VAN DER SCHEER, W. M. 1927 Beiträge zur Kenntnis der mongoloiden Missbildung. Abh. Neurol. Psychiat. Psychol., *41*: 1-162.

WILSON, S. A. K. 1940 Neurology, Vol. 2. Edward Arnold and Co., London.

# THE ABO, MNS, AND Rh-Hr BLOOD GROUPS OF THE MAPUCHE INDIANS OF CAUTÍN PROVINCE, CHILE

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## INTRODUCTION

THE purpose of this paper is to present fuller serological data on the Mapuche Indians, align these data with previously published figures on the Mapuche (Rahm, '31; Henckel, Castelli and Dal Borgo, '41; and Sandoval, Henckel and Givovich, '46), and to discuss the hypothetical gene frequencies of pure blood Mapuche in view of the amount of White admixture in these series. The present series was collected by us in December, 1953, with the encouragement of and a grant from the Council of Scientific Investigations of the Universidad de Concepción. After establishing a field laboratory at the Hospital Regional de Temuco, we were able to secure blood samples from 266 Mapuche located in Temuco and five towns within the province (see table 1). Because of poor samples or obvious White admixture, 8 were not used. Through Drs. A. E. Mourant and R. R. Race we were able to secure a small amount of anti-S serum. Anti-$Rh_0$(D), anti-rh′(C), anti-rh″(E), anti-Hr′(c), and the anti-M and anti-N sera were purchased from the Blood Donor Service, Jamaica, New York. Anti-sera for the ABO groupings were prepared by Dr. Sandoval from the Blood Bank Service, St. Borja Hospital, Santiago.

## MATERIAL AND RESULTS

A full examination was made of the $A_1A_2BO$, and Rh groups of the main series of specimens. The frequencies of the ABO groups are shown in table 2. In calculating the gene frequencies, the Bernstein's formulae, adjusted, were used.

As we expected, the higher frequency of group O and of gene O were in good agreement with our earlier investigations in the same province. Duplication of our previous results in respect to frequencies of the ABO

TABLE 1

| Locality | Total | Not tabulated |
|---|---|---|
| Temuco (Prison) | 10 | |
| Temuco ("Tucapel" Regiment) | 25 | |
| Temuco (Hospital) | 18 | No. 192 Poor sample. No. 209, White. |
| Cajon (Sanitary Unity) | 12 | |
| Cajon (Public School) | 15 | |
| Cajon (Farmer School) | 20 | |
| El Natre (School) | 24 | No. 108 Poor sample. |
| Arquenco (Public School) | 16 | |
| Arquenco (House) | 5 | |
| Labranza (Unicef) | 12 | No. 142 "mestizo." No. 143 Poor sample. |
| Labranza (Public School) | 44 | No. 148 (Boroa type, Blue eyes) No. 279, Red hair. |
| Cholchol (Huichican School) | 57 | |
| Total tabulated | 258 | |

TABLE 2

*The ABO system*

| | Total | Group | | | | Gene Frequencies | | |
|---|---|---|---|---|---|---|---|---|
| | | O | $A_1$ | B | AB | A | B | O |
| Number | 258 | 205 | 35 | 18 | 0 | 0.0701 | 0.356 | 0.8939 |
| Per cent | 99.98 | 79.45 | 13.56 | 6.97 | 0 | | | |

Calculated by Bernstein's formulae.

groups suggests that there has been no important change in the genetic nature of the population during the 8 years which intervened.

The frequencies of the Rh-Hr groups are shown in table 5. The gene frequencies were calculated from Fisher's formulae (see Race and Sanger, '50). All the Mapuche Indians were Rh positives.

The $R_1$ (CDe) gene frequency was also significantly higher than gene $R_2$ (cDE) frequency. Genes r (cde); r′ (Cde); and r″ (cdE) were lacking in our series.

MNS frequencies (see table 3) have not been reported previously from Chile. Our findings on a small sample (59 individuals) are comparable to Chown's data on the Blood Indians of Canada (see Chown

TABLE 3

*The MNS system*

| | Total | MS | NS | MNS | Ms | Ns | MNs |
|---|---|---|---|---|---|---|---|
| Number | 59 | 17 | 4 | 17 | 13 | 1 | 7 |
| Per cent | 99.99 | 28.81 | 6.78 | 28.81 | 22.03 | 1.70 | 11.86 |

| Gene Frequencies | |
|---|---|
| mS | .2438 |
| ms | .4686 |
| nS | .1288 |
| ns | .1596 |

Calculated by Mourant's formulae.

and Lewis, '53). These frequencies are distinctly higher than Salazar-Mallen's ('52) on the Tarasco and Otomí of Mexico; the figures obtained by Sanger ('50) on Australian and New Guinea natives; those from Zotendick ('53) on Bushmen; and those published by Pantin ('53) on Diegueño Indians.

The MN frequencies calculated from Wiener's formulae, alone, in a larger sample (144 individuals) were in good agreement with our earlier figures (see table 4).

TABLE 4

*The MN system*

| | | Group | | | Gene Frequencies | |
|---|---|---|---|---|---|---|
| | Total | M | N | MN | m | n |
| Number | 144 | 68 | 12 | 64 | | |
| Per cent | 99.99 | 47.22 | 8.33 | 44.44 | 0.6944 | 0.3055 |

Calculated by Wiener's formulae.

## DISCUSSION

The history of Araucanian (Mapuche)-White contact in Chile dates from 1541 (see Cooper, '50) and is of such nature as to virtually preclude the selection of a completely "pure" Indian series among the Mapuche. Since, according to the 1920 census, 58,000 of the 105,000 Mapuche were then located in Cautín province, it is apparent that there lay the best opportunity of securing the relatively purest Indian samples. This

TABLE 5

*The Rh-Hr system*

| | Total | $Rh_1Rh_1$ CCDe | $Rh_1rh$ CcDe | $Rh_1Rh_2$ CcDE | $Rh_2$ ccDE | $Rh_0$ cDe | $Rh_zRh?$ CCDE |
|---|---|---|---|---|---|---|---|
| Number | 258 | 113 | 21 | 77 | 32 | 11 | 4 |
| Per cent | 99.97 | 43.79 | 8.13 | 29.84 | 12.4 | 4.26 | 1.55 |

Gene frequencies

| | | | |
|---|---|---|---|
| $R_0$ (cDe) | 0.021 | r (cde) | 0.000 |
| $R_1$ (CDe) | 0.693 | r' (Cde) | 0.000 |
| $R_2$ (cDE) | 0.255 | r'' (cdE) | 0.000 |
| $R_z$ (CDE) | 0.032 | | |

Calculated from Fisher's formulae.

opportunity, of course is, what brought us to Cautín province. However, despite all the care we could exercise, it is likely that the series has White admixture.

If we had any clear idea of the genetic composition of the Indian and the White populations, the blood group frequencies of our Mapuche series could be used in estimating the amount of intermixture. Failing precise data on the parent populations, we have the agreement of Boyd ('49, p. 591) that such estimates are probably not worthwhile. It is also worth noting that even with much better information than we have on the gene frequencies of the parent populations, Chown and Lewis ('53, p. 380) are only willing to estimate that roughly one-sixth of the genes in their Blackfoot and Blood Indians series are attributable to Whites.

It is likely that White admixture in our Mapuche series is greater than the one-sixth for Blackfoot and Blood. Indeed, by employing various formulae on the ABO and MN frequencies, estimates of White admixture range from 30-47%. Unfortunately, these estimates are only based upon hypothetical or assumed frequencies for the White and Indian populations of Chile. For example, using Steven's ('52, pp. 17-20) formulae for $p$ and $q$, we may assume parent White frequencies of 0.27 and 0.08 respectively, and none for either in the case of the pre-contact Mapuche. Yet since all the Mapuche A fell in subgroup $A_1$, with no $A_2$ such as occurs in roughly one out of 4 or 5 group A Europeans, it is by no means certain that the pre-contact Mapuche had no group A. In any case, Stevens' formulae yield an estimated 30% White admixture.

Done another way, by using the simple Ottensooser's ('44) formula on group B, alone, we may assume a frequency of 0.08 for the Whites and none for the pre-contact Mapuche. While it is most likely that the group B now shown by the Mapuche had a White origin, the assumption of 0.08 for $q$ in the Whites may not be close to reality. The estimated amount of White admixture by this overly simplified formula is about 44%. Finally, another estimate may be sought in the MN groups, using the simple formula cited by Boyd ('49, pp. 587-588). Here we have assumed that the White frequency for $n$ would be about 0.42, and since American Indians are high in M and low in N, that a pre-contact Mapuche $n$ frequency would be about 0.20. This estimate of White admixture runs about 47%.

It seems to us, however, that these estimates are altogether too high, specially when r, r′ and r″ (cde, Cde, and cdE) are wholly lacking in the present Mapuche series, although there was a low incidence of these factors in a previously reported one (Sandoval, Henckel, and Givovich, '46). Some incidence of these genotypes could be expected in a population with considerable White admixture; for instance, in a series of 241 Blood Indians gene r had a frequency of 0.06 (Chown and Lewis, '53).

In summary, with no more information than is available to us at present, we cannot give any confident estimate of the amount of White admixture in the Mapuche series. Without any more than the above considerations and our own experience to guide us, we suggest that the White admixture may be somewhere around 25%.

For the translation into English, revision of our work, and numerous kind suggestions we should like to thank Dr. Richard P. Schaedel and Dr. Marshall T. Newman.

SUMMARY

The ABO, MNS and Rh blood groups of 266 Mapuche Indians located in Cautín province have been examined, and 258 anthropologically selected individuals have been studied. High frequency of the O characteristic of the American Indian series was found. Of the A group, only subgroup $A_1$ was present. There was no $A_2$.

M was high. S was higher than in other series investigated in Central America. All the Mapuche Indians were Rh positive. The genes r (cde); r′ (Cde); and r″ (cdE) were absent from the series.

The appraisal of White admixture is discussed, and reasons are given for supposing this admixture to be around 25%.

## LITERATURE CITED

BOYD, W. C. 1949 Gene frequencies and race mixture. Am. J. Phys. Anthrop., n. s. *4*: 587-593.

CHOWN, B., AND M. LEWIS 1953 The ABO, MNSs, P, Rh, Lutheran, K, Lewis, Duffy and Kidd blood groups and the secretor status of the Blackfoot Indians of Alberta, Canada. Am. J. Phys. Anthrop., n. s. *11*: 369-384.

COOPER, J. M. 1950 The Araucanians. Handbook of South American Indians, *2*: 687-760.

HENCKEL, C., CASTELLI, AND DAL BORGO 1941 Algunas observaciones acerca de los grupos sanguíneos M y N en los Indios Mapuche. Boletín Soc. Biología de Concepción (Chile) *15*: 37-41.

OTTENSOOSER, F. 1944 Cálculo do grau de mistura racial a través do grupo sanguineo. Rev. Bras. Biol. *4*: 531-537.

PANTIN, A. M., AND R. KALLSEN 1953 Blood groups of Diegueño Indians. Am. J. Phys. Anthrop., n. s. *11*: 91-96.

RAHM, G. 1931 Sobre los grupos sanguíneos de los Fueguinos. Bol. Soc. Biología de Concepción (Chile), *6-7*: 59-61.

SALAZAR-MALLEN, M., *et al.* 1952 Blood agglutinogens of the Mexicans. Annals of Eugenics, *16*: 351-358.

SANDOVAL, L., C. HENCKEL AND L. GIVOVICH 1946 The blood groups, subgroups and Rh Factor of the Mapuche Indians of the Province of Cautín (Chile). Blood, *1*: 555-559.

SANGER, R. 1950 The MNS blood groups of the Australian aborigenes and New Guinea natives. Nature, *165*: 939-942.

STEVENS, W. L. 1952 Statistical analysis by the ABO system in mixed populations. Human Biol., *24*: 12-24.

WIENER, A. S., *et al.* 1945 Individual blood differences in Mexican Indians with special reference to the Rh blood types and Hr factor. J. Exp. Med., *81*: 559-571.

ZOUTENDIK, A. M., AND A. KOPEC 1953 Blood groups of Bushmen. Am. J. Phys. Anthrop., n. s., *11*: 361-368.

# FURTHER EVIDENCE OF AGE CHANGES IN BODY FORM BASED ON MATERIAL OF D. A. W. EDWARDS

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TO get more evidence on the age changes in the main patterns of body form, the data collected in London by Edwards ('51) and presented in his table III are reevaluated. It may be said at the outset that results are similar to those on Minnesota women (Škerlj, Brožek and Hunt, '53). Howells ('52), for males, and Škerlj ('30 and '38), for females, have also approached this problem with studies of other series.

The questions to be investigated are:

1. Whether Edwards' data, arrived at by measuring the thickness of a fold of skin and subcutaneous fat (skin fold) at 53 sites, support the results obtained by measuring at 10 sites, in women, or even fewer sites, in men (*cf.* Škerlj, Brožek, and Hunt, '53).

2. Whether there is really no difference between nulliparous and parous women, as claimed by Edwards; and

3. Whether there are differences with sex and age in certain parts of the body; that is, whether there are differences in the degree of development of the superficial soft tissues in the superior as against the inferior part of the body or in the trunk as compared with the limbs (*cf.* Škerlj, '30 and '38 and Škerlj *et al.*, '53).

Edwards ('51, pp. 305-306) measured with a skinfold caliper. He says:

> The observations were on patients in the Medical Outpatient Department, in wards, and in the Endocrine Clinic of the Obstetric Hospital. The patients were at first taken at random as they came to the hospital but were later selected according to their total amount of subcutaneous fat, to provide an even distribution of patients over a wide range of obesity in each of the groups described below. Patients were excluded from the series if they suffered from lipodystrophy, oedema, any wasting disease, or any proved endocrine disorder. They were not excluded because of menopausal irregularities only.

The patients were arranged according to sex and maturity in the following groups: 18 prepubertal boys—males of 5 years or older without pubic hair; 10 pubertal boys—males with pubic hair who were not more than 15 years old; 16 men—males of 19 years and older; 14 prepubertal girls—females of 5 years or older whose menarche had not occurred; 22 pubertal girls—females whose menarche had occurred not more than 5 years previously; and, of women whose menarche had occurred at least 5 years previously, 72 nulliparous—who had never been pregnant, 55 parous—but who had not been pregnant within the past year; and 26 menopausal who had had signs or symptoms of menopause regardless of whether they had ever been pregnant or not. Ten additional women who were pregnant at the time of measurement are not further considered here.

In all these individuals skin folds were measured at 53 sites: one on the chin, two on the neck, 10 on the front and side of the thorax, three on the abdomen, 9 on the back and lumbar region, 8 on the upper arm, 8 on the forearm, and 6 each on the thigh and calf.

Following Edwards ('51) the skinfold thicknesses are expressed in percentages of the sum of all 53 measurements. As the numbers in some groups are small some irregularities due to the effects of sampling must be expected.

In the neck, thorax, abdomen, the front and the back, the increase of relative skinfold thickness in males, particularly between puberty and adulthood, is more intensive than it is in females.

There are two peculiarities in these regions in females: 1. the relative fat thickness decreases from prepuberty to puberty in the neck, abdomen and the total front; it decreases from prepuberty to the nulliparous state in the front of the thorax; but it increases from the prepubertal age-group on in the back of the thorax and the total back; 2. the parous women show, in all these regions, except the abdomen, a reversion toward the prepubertal or pubertal state or, at least, the parous women are not intermediate between the nulliparous and menopausal adult females; at any rate, there are at least slight differences between the parous and non-parous.

The lumbar region shows no big differences in the main trend, even though here also males gain more between puberty and adulthood than between prepuberty and puberty. The parous women again reverse the female trend and resemble the pubertal girls; taking the back as a whole, this reversion toward the pubertal condition is very impressive.

In the upper arm, males show almost no differences. The females, however, lose relatively from the prepubertal to the pubertal state, gain to the parous state and then lose again. The total increase in the upper arm is, therefore, very small in females also. In the forearm in both sexes the relative skinfold thickness decreases almost equally except that, in females, the parous women gain a little and the menopausal ones rank below them but above pubertal and nulliparous females.

Considering the trunk above the waist, the relative skinfold thickness increases very intensively in males but much less in females, among whom there is a reversal in the parous state toward pubertal and prepubertal levels. In the trunk below the waist there is also an increase in both sexes; in females the pubertal ones rank lowest and thereafter there is an increase at each stage, although not much in the parous group. When the whole trunk is considered the differences appear even more strikingly: the males gain very intensively, whereas in the females the tendency to increase is broken by the pubertal girls being below the prepubertal ones and parous ones being below the nulliparous; even the menopausal women are far below the adult men in this respect and the parous and nulliparous women are even below the pubertal boys.

In the limbs there is a tendency for the relative skinfold thickness to decrease, particularly in the legs. Pubertal girls show a decrease in the upper limbs but later there is a slight increase. Just the opposite is true of the lower limb: the skin folds are thickest in the pubertal girls, the nulliparous women show a decrease nearly to the prepubertal level, and the parous and especially menopausal women have relatively still smaller skinfold measurements of the inferior extremity. The adult males show an even greater decrease.

There is an interesting sex difference in the distribution of subcutaneous fat in the limbs. In the upper arm of females there seems to be a tendency to lose subcutaneous fat with age at the sites where it is thickest. This is not the case with males, even though there is such a tendency for fat on the inner aspect. In the arm of both sexes the the thickest skinfold is proximal, the thinnest one distal except in pubescent boys, in whom the minimum is on the medial side near the arm pit. In the forearm the maxima are proximal in all groups and the minima distal, but there are variations in whether these are anterior, posterior, medial or lateral (*cf.* Edwards, '51, table III).

In the thigh in both sexes the maxima are proximal and the minima

distal, though again there are variations in the exact location of these.

In the calf the greatest skinfold thickness in females is found on the median aspect just under the knee, and the minima are regularly on the lateral aspect above the ankle. The males are the same as the females except that in prepubescent boys the maxima is on the medial side just above the ankle and the minima is just below the knee.

Considering both extremities, the general tendency in both sexes is to lose subcutaneous fat, particularly from the distal parts.

In the comparison of prepubescent children and the most mature group, it is interesting that, in all respects except the upper arm, the differences are far greater in males than in females. This seems to suggest that males change in body form with age more than do females. The increase in skinfold thickness on the neck and trunk, as well as the decrease on the limbs, is more intensive in men. This is particularly true of the skinfold over the upper part of the spines as well as over the abdomen, on the one hand, and over the thigh and calf, on the other. One is challenged to connect these great changes in the distribution of soft tissues in males with a life expectancy which (in the experience of life insurance companies everywhere) is below that of females. At present this question is perhaps too speculative, but it may be asked whether there is a connection with cholesterol in blood and with atherosclerosis.

In conclusion, then, this analysis, first, supports and enlarges on our previous statement and guess (Škerlj, *et al.*, '53), namely that there is an overall trend with age to lose subcutaneous fat in the limbs, particularly in their distal parts (at least relative to other skinfold thicknesses). We have shown, furthermore, that this trend can be observed in only 10 (or, in men, even fewer) measurements on each person. This is encouraging, for there is seldom time enough on a sufficient number of volunteers for measuring 53 sites or even more (*cf.* Pochin, cited by Edwards, '50), not to mention practical considerations in clinical work when time is an even more important factor.

Second, in respect to the relative skinfold thicknesses, at least in some parts of the body, it seems that the parous women resemble the prepubescent and pubescent girls more than do the nulliparous and menopausal women. This statement does not support the one expressed by Edwards, and further investigation of this question would be useful. At any rate, from tables 1 and 2 it can be seen immediately that many of the percentages for parous women show a tendency to return towards

TABLE 1

*Average skin-fold thicknesses as percentages of total for 53 sites* *

| Group | Females | | | | | Males | | |
|---|---|---|---|---|---|---|---|---|
| | Pre-pubescent | Pubescent | Nulli-parous | Parous | Meno-pausal | Pre-pubescent | Pubescent | Mature |
| Number | 14 | 22 | 72 | 55 | 26 | 18 | 10 | 16 |
| Total skin-fold thick-nesses in mm | 982 | 977 | 930 | 896 | 1001 | 733 | 852 | 662 |
| Neck | 3.4 | 3.1 | 3.3 | 3.4 | 3.5 | 3.6 | 3.6 | 4.4 |
| Thorax front | 15.1 | 14.7 | 14.5 | 14.5 | 16.1 | 15.7 | 16.8 | 18.4 |
| Thorax back | 11.6 | 12.1 | 13.3 | 13.0 | 13.6 | 10.8 | 11.4 | 15.5 |
| Abdomen | 8.5 | 7.6 | 7.9 | 8.4 | 9.2 | 8.1 | 8.5 | 10.3 |
| Lumbar region | 3.4 | 3.9 | 4.2 | 3.9 | 4.2 | 3.2 | 3.5 | 4.8 |
| Upper arm | 15.5 | 15.1 | 15.8 | 16.2 | 15.9 | 14.6 | 14.7 | 14.6 |
| Forearm | 9.6 | 7.8 | 7.6 | 7.9 | 7.8 | 9.8 | 8.3 | 7.2 |
| Thigh | 20.6 | 22.9 | 21.4 | 20.8 | 18.9 | 20.4 | 20.2 | 15.6 |
| Calf | 12.3 | 12.9 | 12.0 | 12.0 | 10.5 | 13.9 | 13.1 | 9.3 |

* The sites are illustrated in Edwards ('51, Fig. 1A). Neck: $A_{1,2}$; $E_1$. Thorax front: $A_{3,4}$; $B_{1,2,3,4}$; $C_{1,2,3,4}$. Back: $D_{1,2,3,4}$; $E_{2,3,4}$. Abdomen: $A_{5,6}$; $B_5$. Lumbar region: $D_5$; $E_5$. Upper arm: $AF_{1,2}$; $AB_{1,2}$; $AO_{1,2}$; $AI_{1,2}$. Forearm $AF_{3,4}$; $AB_{3,4}$; $AO_{3,4}$; $AI_{3,4}$. Thigh: $LF_{1,2}$; $LB_{1,2}$; $LO_{1,2}$. Calf: $LB_{3,4}$; $LO_{3,4}$; $LI_{1,2}$.

TABLE 2

*Relative skin-fold thicknesses as percentages of total on the main parts of the body* *

| | Females | | | | | Males | | |
|---|---|---|---|---|---|---|---|---|
| Group | Pre-pubescent | Pubescent | Nulli-parous | Parous | Meno-pausal | Pre-pubescent | Pubescent | Mature |
| Neck | 3.4 | 3.1 | 3.3 | 3.4 | 3.5 | 3.6 | 3.6 | 4.4 |
| Trunk above the waist | 26.6 | 26.8 | 27.8 | 27.5 | 29.8 | 26.5 | 28.2 | 33.9 |
| Trunk below the waist | 11.9 | 11.5 | 12.1 | 12.3 | 13.3 | 11.3 | 12.1 | 15.1 |
| Upper limb | 25.2 | 22.9 | 23.3 | 24.1 | 23.7 | 24.4 | 23.0 | 21.8 |
| Lower limb | 32.9 | 35.8 | 33.5 | 33.7 | 29.4 | 34.3 | 33.4 | 24.8 |
| *S* vector | 30.0 | 29.9 | 31.1 | 30.9 | 33.3 | 30.1 | 31.8 | 38.3 |
| *I* vector | 70.0 | 70.1 | 68.9 | 69.1 | 66.5 | 70.0 | 68.4 | 61.7 |
| *Tr* vector | 41.9 | 41.3 | 43.2 | 43.1 | 46.6 | 41.4 | 43.8 | 53.4 |
| *Ex* vector | 58.1 | 58.7 | 56.8 | 56.9 | 53.2 | 58.7 | 56.3 | 46.7 |

* Trunk above the waist: thorax, front and back. Trunk below the waist: abdomen and lumbar degion. Upper limb: arm and forearm. Lower limb: thigh and calf. *S* vector: neck and trunk above waist. *I* vector: trunk below the waist and limbs. *Tr* vector: trunk and neck. *Ex* vector: limbs.

those of the younger groups, the prepubescent girls in particular. Even though one tries to think imaginatively about the question, why parous women resemble prepubertal and pubertal girls more than do nulliparous women, an answer, at present, would be more speculative than plausible. And frankly, I, for one, can not as yet find even a reasonable speculative answer.

As to our third question, the changes in relative skinfold thicknesses between the least and most mature groups are greater in the males than in the females. In the neck the increase is about 8 times as great in males as in females. In the trunk above the waist the gain in men is more than twice that in women, and in the trunk below the waist it is almost three times greater. In the total trunk the gain in males is therefore almost three times that in females. Furthermore, the relative loss of fat on the extremities, particularly the lower one, is far greater in men.

In table 2 it may be seen that the skinfolds of the superior part of the body (*S* vector) increase while those of the inferior part (*I* vector) decrease with age. This trend occurs in both sexes but is more marked in males. Similarly there is an increase in skinfolds of the trunk with age (*Tr* vector) as compared to the extremities (*Ex* vector), and this is an even more apparent contrast, particularly in the males. In both these vector continua, the status of the parous females barely break the main tendency to steady change with increased maturity. These results fully support those of Škerlj, Brožek and Hunt ('53) on Minnesota women.

## LITERATURE CITED

EDWARDS, D. A. W. 1950 Observations on the distribution of subcutaneous fat. Clin. Science, *9*: 259-270.

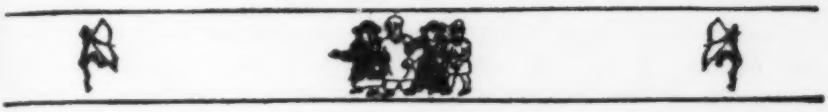
EDWARDS, D. A. W. 1951 Differences in the distribution of subcutaneous fat with sex and maturity. Clin. Science, *10*: 305-315.

HOWELLS, W. W. 1952 A factorial study of constitutional type. Amer. J. Phys. Anthrop., n. s. *10*: 91-118.

ŠKERLJ, B. 1930 Zur physiologischen "Fettleibigkeit" des Weibes. Arch. Frauenkunde, *16*: 235-246.

ŠKERLJ, B. 1938 Die Körperformtypen des Weibes. Acta Neerl. Morph. Norm. et Pathol., *2*: 20-41.

ŠKERLJ, B., J. BROZEK, AND E. E. HUNT, JR. 1953 Subcutaneous fat and age changes in body build and body form in women. Amer. J. Phys. Anthrop. n. s. *11*: 577-600.



# PHYSIQUE, TEMPERAMENT AND SEX RATIO

BY CLARK W. HEATH *

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DURING a study of the relation of pulse rates of college students of 10-15 years ago to various personal and social factors, it was observed that men having the slowest pulses had more daughters than sons when they later married and had families, whereas men with the fastest pulses had more sons than daughters. When the whole range of pulse rates was considered, a relationship with sex ratio was not convincing. Pulse rate, however, is related to various factors of physique and temperament: very athletic men, for example, tend to have quite slow pulse rates. For this reason it was decided to compare at least some of the available factors of physique and temperament with the sex ratio of offspring.

The subjects selected for the Grant Study in 1938-1942 were college sophomores having good health and overtly good social adjustments (Heath *et al.*, '46). They have been followed to date, 191 of them having married and had children. C. C. Seltzer in 1938-1942 carefully somatotyped the young men. E. B. McTernan (Seltzer *et al.*, '48) "psychotyped" the men from their original psychiatric, social and medical records before 1947, when very few offspring had been born. Tables 1 and 2 show that the men in college who had been judged predominantly mesomorphic (the muscular, heavy boned) and predominantly somatotonic (active, physical type of temperament), tended later to have an excess of daughters. Their opposites, the ectomorphic (the thin) and the cerebrotonic (intellectual temperament) tended to have an excess of sons (table 6).

* The author wishes to thank Edward E. Hunt, Jr., Charles C. McArthur and Hugo Muench for their advice concerning this paper.

TABLE 1

*Predominant mesomorphy and sex ratio of offspring*

| | Males | Females | |
|---|---|---|---|
| **ALL CHILDREN** | | | |
| Mesomorphy predominant | 106 | 128 | |
| " not predominant | 106 | 91 | Total No. Families = 187 |
| Total | 212 | 219 | p = .08 |
| **FIRST-BORN** | | | |
| Mesomorphy predominant | 44 | 56 | |
| " not predominant | 50 | 37 | |
| Total | 94 | 93 | p = .07 |

TABLE 2

*Predominant somatotonia and sex ratio of offspring*

| | Males | Females | |
|---|---|---|---|
| **ALL CHILDREN** | | | |
| Somatotonia predominant | 58 | 76 | |
| " not predominant | 155 | 138 | Total No. Families = 186 |
| Total | 213 | 214 | p = .07 |
| **FIRST-BORN** | | | |
| Somatotonia predominant | 21 | 35 | |
| " not predominant | 72 | 58 | |
| Total | 93 | 93 | p = .03 |

There is a loose relationship between groups of college men classified by such criteria of physique and personality and their choices of major studies in college. Table 3 shows that those who had majored in the natural sciences tended to have offspring with a lower sex ratio than those who had majored in verbal, ideational or artistic subjects. The differences are consistent with the expected trends but cannot be considered significant.

In order to check whether the Grant Study findings might be due to an accident of sampling, the college class graduating in 1943 was

TABLE 3

*College field of concentration (major) and sex ratio of offspring*

| | Males | Females | |
|---|---|---|---|
| **ALL CHILDREN** | | | |
| Natural sciences | 68 | 77 | |
| Social studies | 87 | 86 | |
| Arts, letters and philosophy | 67 | 58 | No. of Families = 191 |
| Total | 222 | 221 | p = .56 |
| **FIRST-BORN** | | | |
| Natural sciences | 33 | 31 | |
| Social studies | 35 | 38 | |
| Arts, letters and philosophy | 30 | 24 | |
| Total | 98 | 93 | p = .73 |

tested, after eliminating names of Grant subjects. Special studies had been made upon this class during its freshman year in college (1939) including a shortened somatotyping by C. C. Seltzer. Sex of offspring was obtained from the class tenth reunion report. Table 4 shows again the lowered sex raito for the predominantly mesomorphic, and table 5 shows the same curious relationships between sex ratio and field of concentration. When ratios were determined only for first-born offspring, the same consistencies were found; in fact, the described trends seem to be stronger for first-born than for second- or third-born. Utilizing the first-born, of course, eliminates any possible influence or bias family size might have upon the statistics.

TABLE 4

*Control: Class of 1943 minus Grant Men; mesomorphy and sex ratio of offspring*

| | Males | Females | |
|---|---|---|---|
| **ALL CHILDREN** | | | |
| Mesomorphy predominant | 202 | 192 | |
| " not predominant | 246 | 204 | No. of Families = 413 |
| Total | 448 | 396 | p = .33 |
| **FIRST-BORN** | | | |
| Mesomorphy predominant | 85 | 101 | |
| " not predominant | 124 | 103 | |
| Total | 209 | 204 | p = .08 |

TABLE 5

*Control: Class of 1943 minus Grant Men; college field of concentration (major) and sex ratio of offspring*

| | Males | Females | |
|---|---|---|---|
| **ALL CHILDREN** | | | |
| Natural sciences | 164 | 164 | |
| Social sciences | 171 | 149 | |
| Arts, letters and philosophy | 117 | 85 | No. of Families = 418 |
| Total | 452 | 398 | p = .22 |
| **FIRST-BORN** | | | |
| Natural sciences | 79 | 85 | |
| Social sciences | 84 | 74 | |
| Arts, letters and philosophy | 51 | 45 | |
| Total | 214 | 204 | p = .65 |

Table 6 shows, in abbreviated form, the selected results of comparison between various factors and sex ratio of offspring. While mesomorphy and ectomorphy have shown relations to sex ratio, the third element of fatness (edomorphy in Sheldon's somatotyping) has repeatedly given equivocal results when compared with sex of offspring. It is possible that this accounts somewhat for the relative lack of influence of Ht./$\sqrt[3]{\text{Wt.}}$ upon sex ratio for these groups. Men with Ht./$\sqrt[3]{\text{Wt.}}$ of 13.0 or less in the

TABLE 6

*Other factors and sex ratio of offspring*

| Factor Present in Father | Series | Sex of Offspring | | Sex Ratio | p * |
|---|---|---|---|---|---|
| | | No. Males | No. Females | | |
| Predominant ectomorphy | Grant | 50 | 43 | 1.16 | .08 |
| " " | Class of '43 | 127 | 114 | 1.11 | .99 |
| " cerebrotonia | Grant | 125 | 100 | 1.25 | .02 |
| Ht./$\sqrt[3]{\text{Wt.}}$ 13.0 or less | Grant | 110 | 127 | 0.87 | .18 |
| " " | Class of '42 | 93 | 101 | 0.92 | .48 |
| " " | Class of '43 | 242 | 213 | 1.14 | .99 |
| Large tidal air (600 cc or more) | Grant | 83 | 108 | 0.78 | .08 |
| Recovery index, 65 or more | Grant | 70 | 94 | 0.74 | .05 |
| Major in Englhs and language | Grant | 52 | 42 | 1.24 | .25 |
| " " " " " | Class of '43 | 86 | 67 | 1.28 | .45 |
| " " chem., physics, math. | Grant | 54 | 61 | 0.89 | .45 |
| " " " " " | Class of '43 | 93 | 109 | 0.85 | .47 |
| Labelled by trait: practical organizing | Grant | 71 | 102 | 0.70 | <.01 |
| " " " : cultural | Grant | 51 | 32 | 1.59 | .02 |
| Weak masculine body build | Grant | 81 | 76 | 1.07 | .46 |
| " " " " | Class of '43 | 50 | 42 | 1.19 | .42 |

* By the Chi-square Test, usually a 2 × 2 table being used, comparing offspring of men possessing the factor with those of men not possessing it.

Class of 1943 had about the expected sex ratio of their offspring. However this factor is available for other classes and was tried with the Class of 1942, showing a consistent reduction of sex ratios for fathers with low Ht./$\sqrt[3]{\text{Wt.}}$ A large tidal air (volume of air per inspiration at rest) is found somewhat more commonly in the more athletic and mesomorphic young men than among their opposites and was used for further com-

parisons. "Recovery index" is a measure of physical fitness for hard muscular work, higher scores indicating higher fitness (Johnson *et al.*, '42). Although $p$ is only occasionally .05 or less, the figures are consistently in the expected direction. The relationship of these various factors with sex of offspring is consistent with the hypothesis: muscular and active fathers tend to have more daughters than sons; thin and intellectual fathers tend to have more sons than daughters. That the phenomenon is more complex than this is suggested by the last item in table 6: weak masculine body build (Seltzer, '45). Such individuals are not thin usually, but they tend to have more boy than girl babies.

It is suggested that some common factor may be acting in the body to modify both physique and temperament and the sex of the offspring. It is hoped that interested observers will pursue these studies for other and larger groups. It would seem, however, that the most fruitful inquiry might be among known biochemical body constitutents which may be related to physique and temperament. No definitely corroborative work has been found in the literature. In a personal communication E. E. Hunt, Jr. says that the findings are in accord with some which he has made on the people of the island of Yap. No comparable long-term data are available for women.

## LITERATURE CITED

HEATH, C. W. *et al.* 1946 What People Are. Harvard University Press, Cambridge, Massachusetts.

JOHNSON, R. E., L. BROUHA AND R. C. DARLING 1942 A test of physical fitness for strenuous exertion. Revue canadienne de Biol., *1*: 491-503.

SELTZER, C. C. 1945 The relationship between the masculine component and personality. Amer. J. Physical Anthrop., n. s. *3*: 33-47.

SELTZER, C. C., F. L. WELLS AND E. B. MCTERNAN 1948 A relationship between Sheldonian somatotype and psychotype. J. of Personality, *16*: 431-436.

# PHYSICAL DEVELOPMENT IN THE ENGLISH AND THE AMERICAN PRE-SCHOOL CHILD

## A COMPARISON BETWEEN FINDINGS IN THE OXFORD AND THE BRUSH FOUNDATION SURVEYS[1]

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### INTRODUCTION

THE most widely used method of assessing the skeletal maturity of a child is to compare a radiograph of its hand with a series of standard films which have previously been chosen as typical of various ages. The standard films generally used for this purpose are those published by Todd ('37) in his *Atlas of Skeletal Maturation* and in the revised version of this atlas by Greulich and Pyle ('50). Since the films in these atlases were chosen to be typical of a group of well-to-do, white children reared in one district in the U. S. A. "there is no reason to expect that they will fit exactly any other group. . . . But standards do not have to fit exactly in order to provide an adequate assessment of skeletal status. They can be somewhat or even much advanced or retarded as compared with the rate of skeletal development of a group of children to whom they are applied, and still permit one to determine how the skeletal status of any child in that group compares with the others of his age and sex, as well as with the children on whom the standards are based." (Greulich and Pyle, '50). In a previous study Todd's atlas was used to assay some factors influencing the skeletal maturation of children in the Oxford Child Health Survey (Acheson and Hewitt, '54). In this paper the same atlas has been used to compare the maturation of these English children at Oxford with that of American children in the Brush Foundation Study at Cleveland.

[1] The Oxford Child Health Survey has been financed by grants from the Medical Research Council and the Nuffield Provincial Hospitals Trust.

## MATERIAL

The purpose of the Oxford Child Health Survey was to keep under continuous observation, for a period of 5 years, 500 babies born in or near the city after January 1, 1944, and to obtain for these children serial records of interest to clinicians and social workers. A special effort was made to recruit children from all economic levels. This is in sharp contrast with the selection practised in the Brush Foundation Study where "the intention was to confine this sampling to children who would be reasonably free from physical, mental and nutritional handicaps to that growth and development pattern normal for each child; to children who would be reasonably free, that is, from environmental handicaps to the realization of their inherited potentialities," (Simmons, '44). Thus the Oxford Survey sought to examine the effect of an environment on development, while the Brush Study aimed at describing the process of development in an optimal environment.[2]

At the age of 6 months, and at 6-monthly intervals thereafter, X-rays were taken of the chest, of both hands and both knees. In addition each child had one of the following anatomical parts X-rayed: spine, skull, feet or pelvis. About 90% of the hand X-rays were assessed by an expert radiologist, the remainder by his trainee (R. M. A.) who repeatedly checked his own and his instructor's assessments. All assessments were made to the nearest Todd standard, i. e., to the nearest whole three months of "skeletal age" for the first year and a half of life and thereafter to the nearest whole 6 months. It was felt that any attempt to interpolate within these limits might lead to spurious accuracy. This degree of approximation does not affect the comparison of English and American mean values, but makes it inappropriate to compare standard deviations of skeletal age.

### *Maturation of English Children compared with Todd's Standards*

The first step in the analysis was to see whether or not the skeletal development of the Oxford children conformed to the general pattern of the Todd atlas ('37). It was not to be expected that the mean skeletal

[2] Since the methods, as well as the dates, of recruitment differed so much between the surveys these samples must not be regarded as equally representative of conditions in England and America. Though we have found it convenient to refer to "the English children" and "the American children" we do not wish to claim that we have made any valid comparisions of general standards of development in the two countries.

age of the Oxford children would be identical with their calendar age, nor even that any difference between the two would remain constant throughout childhood. But the mean skeletal age of any group of healthy children should, by definition, bear a linear relationship to the mean calendar age. When these two quantities were plotted against one another, it was found that the points for boys could be adequately

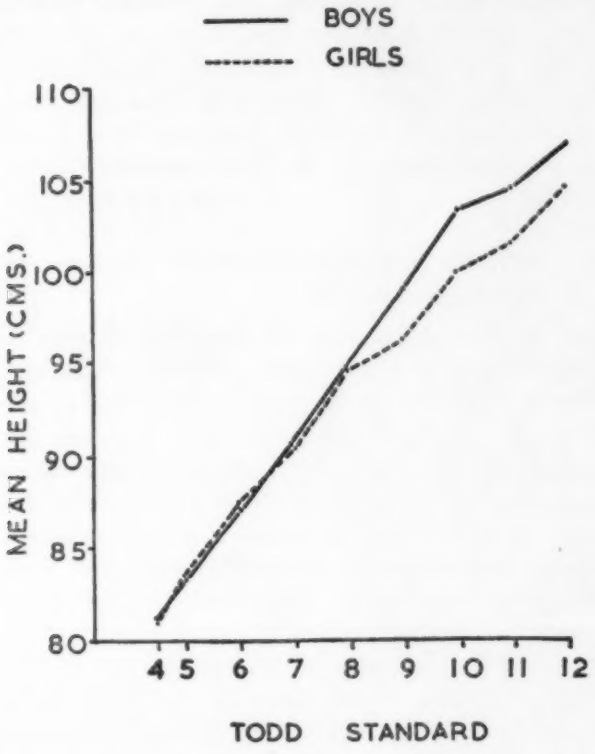


FIG. 1. HEIGHT OF OXFORD BOYS AND GIRLS RELATED TO TODD'S STANDARDS OF SKELETAL MATURITY.

represented by a straight line, thus confirming that the Todd standards were applicable to Oxford boys. But the points for girls appeared to follow a curve concave towards the skeletal age axis. That is to say, there was a tendency for the maturation of these girls to accelerate relative to the Todd standards. This could have been due either to a peculiarity in the rate of development of the Oxford girls or to a fault in the standards themselves. Figure 1 suggests that the latter is the more likely alternative.

In this figure are plotted the mean heights of all boys and all girls observed at each of the Todd standards from the fourth to the twelfth. At standards Four to Eight inclusive there are only trivial differences in height between the sexes. Between standards Eight and Nine the boys grew at the same rate as before, while the girls appeared to grow only half as much. From standard Nine onwards the two sexes were again very similar in rate of growth. The difference between the sexes which figure 1 seems to show is so abrupt and short-lived that it must be regarded as an artificial effect, and may result from an error in making the female standards Eight and Nine too similar to one another. Apart from this one flaw, however, there seems no reason to question the applicability of the Todd standards to the boys and girls of Oxford.

*Growth and Maturation of Oxford Children compared with that of Brush Foundation Children*

The data on skeletal maturity of American children used in this section are those based on Todd's atlas ('37) but which were published by Greulich and Pyle ('50) in the introduction to their work. Standing heights of the same children have been taken from the monograph by Simmons ('44). In both the Oxford and the Brush surveys the two-year examination was the earliest at which all the children were able to co-operate in the measurement of stature. A large proportion of them had, however, been satisfactorily measured at the age of 18 months, and most of the comparisons which follow cover the age range one and a half to 5 years.

In tables 1 and 2 the mean heights of the Oxford boys and girls are set against the corresponding means for the Brush Survey children. It will be seen that in every case the Oxford children were shorter than the American children of the same age. The height difference, in absolute measure, increased from about 7 mm at 18 months to about 22 mm at the age of 5. The lag of the Oxford children also appeared to increase from approximately one-quarter to one-half of a standard deviation.

A small part of the difference between the findings of the two surveys may be due to the fact that the American children who were "dressed in indoor clothing, shoes removed" (Simmons, '44) presumably wore socks at the time of measurement, whereas the English children were measured barefoot. A second reason for differences can be inferred

TABLE 1

TABLE 1

*Height of Oxford and Brush survey boys*

| Calendar Age (months) | Oxford Survey | | | Brush Survey | | | Deviation of Oxford Mean from Brush Survey Mean | |
|---|---|---|---|---|---|---|---|---|
| | No. of boys | Mean Height (mm) | S. D. (mm) | No. of boys | Mean Height (mm) | S.D. (mm) | In mm | In S. D. (Brush) units |
| 18 | 135 | 812.55 | 32.97 | 99 | 818.62 | 26.74 | — 6.07 | —0.23 |
| 24 | 254 | 865.38 | 35.26 | 164 | 874.10 | 31.80 | — 8.72 | —0.27 |
| 30 | 240 | 907.80 | 36.65 | 170 | 922.18 | 31.81 | —14.38 | —0.45 |
| 36 | 242 | 949.96 | 40.61 | 195 | 963.64 | 34.46 | —13.68 | —0.40 |
| 42 | 239 | 989.84 | 42.90 | 193 | 1002.56 | 35.65 | —12.72 | —0.36 |
| 48 | 243 | 1023.11 | 44.07 | 216 | 1039.53 | 36.20 | —16.72 | —0.46 |
| 54 | 225 | 1057.66 | 43.79 | 213 | 1075.89 | 38.74 | —18.23 | —0.47 |
| 60 | 234 | 1088.90 | 48.13 | 225 | 1106.71 | 40.48 | —17.81 | —0.44 |

TABLE 2

*Height of Oxford and Brush survey girls*

| Calendar Age (months) | Oxford Survey | | | Brush Survey | | | Deviation of Oxford Mean from Brush Survey Mean | |
|---|---|---|---|---|---|---|---|---|
| | No. of girls | Mean Height (mm) | S. D. (mm) | No. of girls | Mean Height (mm) | S.D. (mm) | In mm | In S. D. (Brush) units |
| 18 | 129 | 792.73 | 32.82 | 95 | 800.40 | 33.33 | — 7.67 | —0.23 |
| 24 | 262 | 846.07 | 32.28 | 165 | 860.85 | 31.85 | —14.81 | —0.46 |
| 30 | 259 | 894.33 | 36.91 | 166 | 911.34 | 33.42 | —17.01 | —0.51 |
| 36 | 263 | 935.74 | 36.78 | 186 | 953.99 | 35.69 | —18.25 | —0.51 |
| 42 | 246 | 976.88 | 36.86 | 192 | 995.26 | 36.18 | —18.38 | —0.51 |
| 48 | 250 | 1012.95 | 38.91 | 222 | 1033.02 | 37.45 | —20.07 | —0.54 |
| 54 | 238 | 1045.72 | 40.59 | 218 | 1071.81 | 42.66 | —26.09 | —0.61 |
| 60 | 238 | 1079.75 | 43.61 | 225 | 1106.42 | 43.71 | —26.67 | —0.61 |

from the figures in tables 1 and 2. These show that compared with Americans of the same age, English children tended to be in a slightly earlier phase of height gain. During the years covered by these tables, girls, who are distinctly shorter than boys in infancy, gain one or two centimeters more in height than do boys. This tendency for the heights of the sexes to converge means that, of any two groups of children, the

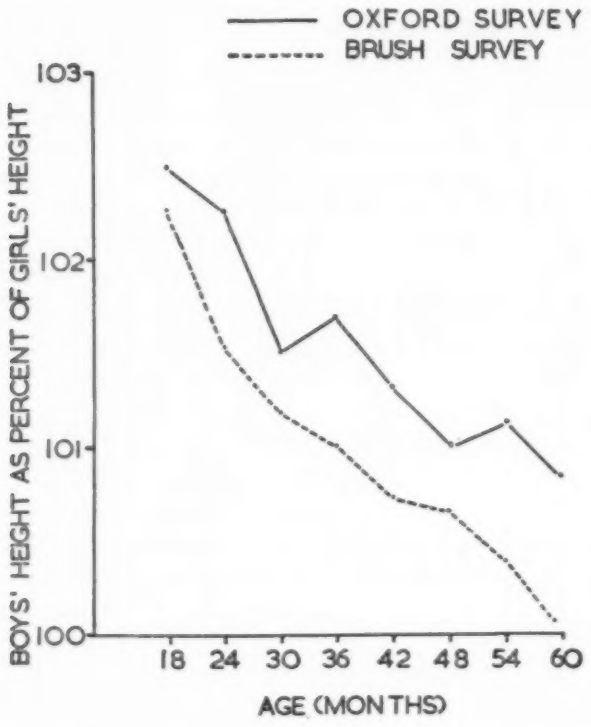


FIG. 2. MEAN HEIGHT OF BOYS AT VARIOUS AGES AS A PERCENTAGE OF THE CORRESPONDING MEAN FOR GIRLS.

one with the *smaller* excess of male over female height is at a more advanced stage of physical development and nearer to final, adult height. Figure 2 shows that, by this criterion, the children of the Brush Survey were well ahead of the Oxford children. This implies that a comparison of the English and the American heights based on equally mature children would be more favorable to the English children than the comparisons made above.

There is one further point in tables 1 and 2 which deserves comment. It will be noticed that the standard deviations of the heights recorded in Oxford were greater than those found in the Brush survey and that this excess is more characteristic of the boys (with a standard deviation averaging about 18% wider than the American boys) than of the girls (standard deviation only about 2% wider than the American girls). This is interesting in view of Parnell's observation that an economically favored group, as well as being tall, has an unusually compact height distribution (Parnell, '51). It also accords with the suggestion that, when comparisions are made between children of equal calendar age, environment has more effect on the heights of boys than of girls (Greulich, '51; Greulich, *et al.*, '53; Acheson and Hewitt, '54).

In tables 3 and 4 the mean skeletal ages reached by the Oxford boys and girls are compared with those reached by Brush Survey children of equal age. Once again the English children (of both sexes and at all ages) appear to be lagging behind the Americans. At the age of one and a half the English boys were 5 "skeletal months" behind; at the age of 5 the gap had widened to about 8 "skeletal months." In terms of the (American) standard deviation the skeletal maturity of the English boys was considerably more retarded than their size. While the height difference, measured in standard deviations, was increasing with age (see table 1 above), the maturity difference was decreasing. At the age of one and a half the English girls were about 5 "skeletal months" behind, but thereafter they showed no tendency to lose ground so that, in terms of the standard deviation, they were closing up on the Americans more rapidly than the boys.

The evidence of tables 3 and 4 strengthens the inference drawn from figure 2 that the English children tended to be in an earlier phase of physical development than American children of equal age. This relative immaturity of the English children may be regarded as a second aspect of general physical backwardness, possibly due to a sub-optimal environment for a growing child. In the long run, however, some degree of skeletal retardation may prove an asset to children whose growth is slow. For the longer the period that remains before the final closure of the epiphyses the more chance there is of catching up in height with other, more rapidly developing children.

In view of these findings it is reasonable to compare the mean heights of the Brush sample as a whole with the mean heights from other surveys on the basis of equal skeletal ages as well as equal calendar

TABLE 3

*Skeletal maturity of Oxford and Brush survey boys*

| Calendar Age (months) | Oxford Survey | | Brush Survey | | | Deviation of Oxford Mean from Brush Survey Mean | |
|---|---|---|---|---|---|---|---|
| | No. of boys | Mean skeletal age (months) | No. of boys | Mean skeletal age (months) | S. D. | Mean skeletal age (months) | In S. D. (Brush) units |
| 18 | 298 | 14.4 | 106 | 19.36 | 3.52 | —4.96 | —1.41 |
| 24 | 293 | 21.1 | 105 | 25.97 | 3.92 | —4.87 | —1.24 |
| 30 | 248 | 26.6 | 107 | 32.40 | 4.52 | —5.80 | —1.28 |
| 36 | 247 | 32.9 | 127 | 38.21 | 5.08 | —5.31 | —1.05 |
| 42 | 242 | 37.5 | 138 | 43.89 | 5.40 | —6.39 | —1.18 |
| 48 | 244 | 42.0 | 170 | 49.04 | 6.66 | —7.04 | —1.06 |
| 54 | 225 | 48.5 | 176 | 56.00 | 8.36 | —7.50 | —0.90 |
| 60 | 234 | 53.9 | 191 | 62.43 | 8.79 | —8.53 | —0.97 |

TABLE 4

*Skeletal maturity of Oxford and Brush survey girls*

| Calendar Age (months) | Oxford Survey | | Brush Survey | | | Deviation of Oxford Mean from Brush Survey Mean | |
|---|---|---|---|---|---|---|---|
| | No. of girls | Mean skeletal age (months) | No. of girls | Mean skeletal age (months) | S. D. | In months | In S. D. (Brush) units |
| 18 | 289 | 13.5 | 93 | 18.22 | 3.49 | —4.72 | —1.35 |
| 24 | 289 | 18.6 | 101 | 24.16 | 4.64 | —5.56 | —1.20 |
| 30 | 263 | 24.9 | 98 | 30.96 | 5.37 | —6.06 | —1.13 |
| 36 | 263 | 32.9 | 133 | 36.63 | 5.97 | —3.73 | —0.62 |
| 42 | 248 | 37.5 | 131 | 43.50 | 7.48 | —6.00 | —0.80 |
| 48 | 252 | 45.7 | 154 | 50.14 | 8.98 | —4.44 | —0.49 |
| 54 | 239 | 53.1 | 152 | 60.06 | 10.73 | —6.96 | —0.65 |
| 60 | 235 | 60.9 | 167 | 66.21 | 11.65 | —5.31 | —0.46 |

ages. This has been done in figure 3 where the mean height of each age-group is plotted, not against the age itself but against the corresponding mean skeletal age. These graphs should be thought of as having a limit on the skeletal age scale at 225 "skeletal months" for boys and 195 for girls. After reaching the limit there can be no further increase

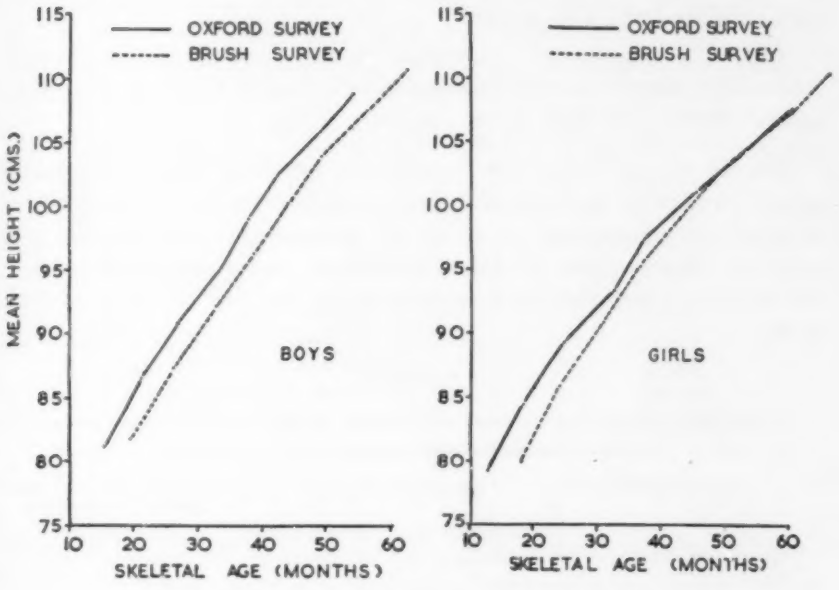


FIG. 3. RELATION BETWEEN HEIGHT AND SKELETAL AGE.

of skeletal age or of height. The Oxford data only cover the first third of the range, so that it is not possible to make any confident statements about the final heights of the English children. There is, however, a *prima facie* case for regarding the group who are represented by the highest line on such a graph as potentially the tallest. In figure 3 the line for English boys lies distinctly higher than that for American boys; the line for English girls is at first higher than and then indistinguishable from that for American girls. Thus the height and maturity comparisons which, taken separately, show the English children as a relatively backward group also imply, when they are taken together, that

the English children may become as tall or even taller than the Americans in adult life. It would, however, be unwise to accept this finding at its face value, since:

(1) The two samples were not observed contemporaneously.

(2) Relationships between environment and development which obtain during the first 5 years of life do not necessarily persist through later childhood and adolescence.

(3) The methods of comparison so far adopted are particularly vulnerable to any systematic bias in the recording of height or of skeletal age in either the English or the American data.

Should any such bias run through the records it can be eliminated (provided it takes the form of a constant absolute error) by making the international comparison in terms of increments instead of absolute amounts. This is shown in table 5 which sets out the differences between the two year [3] and the 5-year means for height and for stage in each survey.

TABLE 5

*Increase in height and skeletal maturity of Oxford and of Brush survey children between the ages of two and five years*

| | | Oxford Survey increase | Brush Survey increase | Oxford increase as percentage of Brush increase |
|---|---|---|---|---|
| *Height* (mm) | Boys | 223.52 | 232.61 | 96% |
| | Girls | 233.68 | 245.57 | 95% |
| *Skeletal Maturity* (months of skeletal age) | Boys | 32.8 | 36.4 | 90% |
| | Girls | 42.3 | 42.0 | 101% |

Over this age range the Oxford children of both sexes gained about 5% less in height; in skeletal maturity the Oxford boys gained about 10% less while the girls gained equally in the two surveys. It would be more instructive to make the comparisons of height gain over a period of development defined by skeletal rather than calendar ages. This can

[3] The age of two was taken rather than one and a half because of the greater numbers available.

be done, but we must be prepared to ignore the possibility of errors arising from bias in the recording of skeletal age (systematic errors in the heights are assumed not to affect height increments). The appropriate procedure is illustrated in table 6. This table shows that between the

TABLE 6

*Increase in height of Oxford and of Brush survey children: Comparison made over same phase of skeletal maturation*

| | | Oxford Children | | Brush Children |
|---|---|---|---|---|
| | | Height | Skeletal Age | Height interpolated * at corresponding skeletal age |
| Boys | Age 2 | 865.38 | 21.1 | 833.22 |
| | Age 5 | 1088.90 | 53.9 | 1065.01 |
| | Increase | 223.52 | — | 231.79 |
| | % of Brush Increase | 96.4% | — | 100.0% |
| Girls | Age 2 | 846.07 | 18.6 | 804.27 |
| | Age 5 | 1079.75 | 60.9 | 1076.54 |
| | Increase | 233.68 | — | 272.27 |
| | % of Brush Increase | 85.8% | — | 100.0% |

* Interpolation by proportional parts between adjacent points e. g. boys aged two: $818.62 + \frac{21.1 - 19.36}{25.97 - 19.36} (874.10 - 818.62)$.

21st and 54th "skeletal months," Oxford boys were estimated to gain 96% of the height gained by the Brush boys; while the Oxford girls, between the 19th and 61st "months" were estimated to gain only 86% of the height gained by the Brush girls. Thus the rate of increase in height per unit increase in skeletal maturity (on which adult stature ultimately depends) was greater for the American boys and girls than for the English children. The English girls appeared to be relatively further behind than the boys, not so much because their rate of growth relative to time fell any further short of the American stan .d, but because, unlike their brothers, these English girls matured as rapidly as the Americans.

DISCUSSION

Todd referred to the age associated with any standard radiograph as the "skeletal age" of the child concerned, and established the convention of treating skeletal ages as if they were points on some absolute scale of skeletal maturity. In fact no such scale has yet been devised,

and the student of maturation is still in a position which may be likened to that of a student of weight gain who has been equipped with a balance but cannot put more than one object in each pan. By a series of balancing experiments he can identify the median child in each age-group, and then, using these children as his weight standards, he can estimate what he might call the " ponderal age " of the other children. He could then compare the mean ponderal ages of different racial or economic groups and reach some valuable conclusions. But he could never discover, for example, those phases in childhood when weight gain is relatively fast or slow. Elsewhere one of us (Acheson, '54) has criticized the concept of skeletal age, suggested an alternative method of assessing radiographs, and applied this to the hand and knee films of the Oxford children. For the purpose of comparison with the Brush Foundation children it is, however, necessary to adopt the only method of assessment which has been applied in both surveys, and with it Todd's concept of skeletal age.

The comparisons made in this paper are complicated by the fact that the two groups of children were of different stock. Though the American children were all white and the majority of them were of North European descent, their racial antecedents were probably more mixed than the Oxford group, who were mostly English with the usual admixture of Irish and Scottish ancestry. It may be, therefore, that the children of one of the samples had a greater inherited potentiality for growth, or that there was some difference in their natural mean rates of maturation.

The contrast in environment is less problematic. On average, the environment and home circumstances of the American children must have been more favorable because of the different methods by which the two samples were selected.[4] Therefore any difference between the English and the American children which can be paralleled by a difference between poorer and richer children within the English sample may plausibly be regarded as an effect of differing environments. In fact three findings of the present paper parallel the findings in our previous study of growth and maturation in contrasted economic strata of Oxford (Acheson and Hewitt, '54):

(1) In both studies the boys and girls who grew up in the worse environment were shorter than other children of the same calendar age. The difference between the average height of the Oxford and the

[4] See footnote 2.

Cleveland samples was of the same order of magnitude as the difference between children of unskilled and of professional parents in Oxford.

(2) In both studies the boys from the worse environment were skeletally less mature than other boys of the same calendar age. Here the Oxford-Cleveland difference was rather greater than the social class difference. In both studies environment appeared to have less effect on the maturation of girls than on that of boys, for the Oxford-Cleveland difference in maturity was slightly less for girls than for boys, and in the social class comparison no effect on the maturation of girls could be detected at all.

(3) Comparison of the children on the basis of equal skeletal age (rather than equal calendar age) suggested that the effect of environment on final stature might be greater for girls than for boys.

Comparisons of Guamanian with Cleveland children (Greulich, '51), and of children exposed to atomic bombing with other Japanese children (Greulich, *et al.*, '53) also bear out findings (1) and (2).

## SUMMARY

The physical development of approximately 500 Oxford children, from different economic levels, followed over the first 5 years of life, is compared with that of the Brush Foundation children. On average the English children are shorter and less skeletally mature (Todd). In order to avoid systematic error arising from possible differences in anthropometric technique, increments are studied. The English increments as a percentage of the American are estimated as:

(1) Stature increase per unit time: boys 96%, girls 95%.

(2) Skeletal maturity increase per unit time: boys 90%, girls 101%.

(3) Stature increase per unit skeletal maturity increase: boys 96%, girls 86%.

These findings parallel those found between the different economic strata within the Oxford Survey.

## LITERATURE CITED

ACHESON, R. M. 1954 A method of assessing skeletal maturity from radiographs: a report from the Oxford Child Health Survey. J. Anatomy (London), *88*: 498-508.

ACHESON, R. M., AND D. HEWITT 1954 Oxford Child Health Survey: Stature and skeletal maturation in the pre-school child. Brit. J. Prev. Soc. Med., *8*: 59-65.

GREULICH, W. W. AND S. I. PYLE 1950 Radiographic Atlas of Skeletal Development of the Hand and Wrist. Stanford University Press. Stanford, Calif.

GREULICH, W. W. 1951 The growth and delvelopmental status of Guamanian school children in 1947. Am. J. Phys. Anthrop., n. s. *9*: 55-70.

GREULICH, W. W., C. S. CRISMON AND M. L. TURNER 1953 The physical growth and development of children who survived the atomic bombing of Hiroshima or Nagasaki. J. Pediat., *43*: 121-145.

PARNELL, R. W. 1951 The Health of Undergraduates. D. M. Thesis (unpublished) Bodleian Library, Oxford, England.

SIMMONS, K. 1944 The Brush Foundation study of child growth and development: II. Physical growth and development. Soc. Res. Child Dev. Monog., *9*: Washington.

TODD, T. W. 1937 Atlas of Skeletal Maturation—The Hand. Mosby and Co., St. Louis.

# BOOK REVIEWS

*The Fourth Mental Measurements Yearbook.* Edited by O. K. Buros, 1163 pp., the Gryphon Press, Highland Park, New Jersey, 1953, $18.00.

While the development of new tools for mental measurement is a highly technical job, standardized "mental tests" have a wide usage in research in a variety of segments of human biology as well as a practical application in educational, industrial, military, and psychiatric contexts. It is the aim of the *Yearbook,* and of its six predecessors, to assist the potential test users in locating and evaluating tests and books on testing published from 1948 through 1951.

The successive editions, each containing new materials and thus supplementing rather than supplanting the earlier volumes, have been growing steadily in size and in the number of items reviewed. The first section of the present edition covers some 800 tests. In addition to the reviews of tests which had been already published in a wide array of journals, there is a large number of reviews written specifically for the *Yearbook.* For purposes of orientation it may be useful to group the tests in 5 categories: sensory-motor (20 pp.), intelligence (112 pp.), character and personality (226 pp.), aptitudes and achievement (reading, English, foreign languages, fine arts, mathematics, science, social studies, achievement batteries, vocations) and the unavoidable "miscellaneous" left-overs (accounting together for some 460 pages of the text). There are over 4,000 references to publications dealing with the construction, validation, and use of the tests.

The second section contains titles and, in most instances, reviews of over 400 books. Some books are reviewed by several authors. This adds up to a total of 758 book reviews taken, in part or *in toto,* from 121 journals. No original book reviews were solicited for this section. The use of the massive volume is facilitated by three indexes, as well as the directory and index of periodicals and publishers.

In the days characterized by an overabundance of books and papers in almost any field of scientific endeavor, synthesizing efforts are badly needed to register and evaluate the "output." In the field of mental measurement, Buros' *Yearbooks* have served this purpose well. For the

future, in which the output may be expected to continue high, a more selective attitude may be the only way to save this valuable enterprise from collapse due to the sheer weight of the material and reduced sale volume resulting from a high price. Even now, while the volume should certainly find its way to all the libraries in which a comprehensive reference book on the tools and theories of psychological testing is needed, the individual user may pause before making out so large a check even though he would *like* to have the book on his shelf.

JOSEF BROŽEK

*The African Mind in Health and Disease; A Study in Ethnopsychiatry,* by J. C. CAROTHERS. 177 pp. World Health Organization, Geneva, Monograph No. 17, 1953. Paper bound, $2.00.

Readers of *Human Biology* will find fascinating this well written monograph incorporating the contributions of anthropology, sociology, psychology, psychiatry, human physiology, pathology and nutrition to the study of the mind of the African.

Of Africa's 170,000,000 native people, about 110,000,000 are Negroid, living south of the Sahara Desert and long isolated, genetically and culturally. This is a unique phenomenon, of particular interest to students of man's mental apparatus. For this reason, the World Health Organization thought it worthwhile that a review and commentary be written on this subject and commissioned Dr. Carothers to do so. The author was reared in South Africa and worked for 21 years in Kenya. Of this time, 12 years were spent at the mental hospital in Nairobi.

The monograph consists of three sections: I. The Physical Background of the African; II. The Mind of the African; and III. Discussion on Evolution and Culture.

First, the author defines in the dimensions of anthropology, genetics, geography, and climatology the peoples of his study. They live in a vast, inaccessible region of low population density, subject to intense solar radiation, fluctuation between ill-spaced rains and drought, and on soil generally deficient in calcium and phosphorous. Attention is directed to the effects of genetic, infectious, deficiency, endocrine, neurological, hematopoietic and addictive diseases. The cultural conditions under which the African develops are characterized in the oral period by prolonged, extraordinarily indulgent nursing, ending abruptly between the 24th to 36th month; in the anal-muscular period by the absence of

social training, with answers to "why" being given in magical animistic absolute terms which stifle curiosity; and in the oedipal period by uninhibited childhood sexual play. Due to an absence of toys, manipulative skill and form perception is not developed. By adolescence, processes favoring individualistic development have ceased and pressures to fit into a rigid static social framework become dominant. In adulthood, the behavior patterns are fixed, and "life is governed by rules and taboos which are meticulously anchored to the land. Free expression is limited to oratory, music, dance, and the weaving of fairy tales." Super-ego is but slightly internalized, the deterrent to aberrant action lying not within the individual but within the public opinion.

To disentangle the parts that constitutional and evironmental factors play in producing distinctive characteristics in the mentality of the African, the author proceeds to describe what studies have been made and to assess their merits from the viewpoint of his own multidisciplinary perspective. The African has been described as "conventional; highly dependent upon physical and emotional stimulation; lacking in spontaneity, foresight, tenacity, judgment and humility; inapt for sound abstraction and logic; given to phantasy and fabrication, and, in general, as unstable, impulsive, unreliable, irresponsible, and living in the present without reflection or ambition, or regard for the rights of people outside his own circle. To counteract these ruderies, he has also been described as cheerful, stoical, self confident, sociable, loyal, emotionally intuitive and eloquent, and as bearing no grudges and having an excellent memory, a large vocabulary and an aptitude for music and the dance."

Chapter VII, on "Psychology in Relation to Environment" is excellently presented. Its main theme is that preliterate African man has through hundreds of generations developed a culture along such lines as to "reduce the exigencies of living to a minimum so that the integration which the rural African apparently achieves is founded on the continuing support afforded by his culture to the end that he has but little independent existence in himself." Superimposed upon these basic traits are the deleterious effects of malnutrition and disease which in turn may at various times influence the patterns of his culture.

Included in the monograph is a long, interesting chapter on psychopathology. Emotions easily dominate the African's mind. Stresses are not handled intrapsychically by neuroses, as known to Europeans, but by the rules, laws and taboos of the social framework. Psychoses have their structure so altered by lack of strong integrational patterns in the

ego that they assume amorphous and abortive forms. With vitality, drive and individual maturation severely affected by malnutrition and disease, solution of the nutritional and infection problem is a prerequisite for establishing and maintaining efficient mental function.

J. Victor Monke

*Catalogue des Hommes Fossiles.* Edited by Henri V. Vallois and Hallam L. Movius, Jr. Reprint, Fasc. V Comptes Rendus XIX$^{e}$ Congrès Géologique International. Alger, 1952, pp. 59-378 (1-320). Francs 500.

The present catalogue consitutes a complete record of all fossil human remains known to exist or described up to the year 1952. W. & A. Quenstedt's *Fossilium Catalogue. Hominidae Fossiles* (W. Junk, The Hague, 1936) brought the material up to 1935, but this excellent work was so costly that its circulation was severely restricted. F. Hue's *Crânes Paléolithiques* (Société Préhistorique Française, Paris, 1937) which brought the material up to the year 1936, for some reason seems to have enjoyed an even narrower circulation. During the last 20 years many important discoveries of fossil hominid and hominoid remains have been made, so that an up-to-date catalogue has been a desideratum.

With the aid of 33 collaborators the editors and the Union Paléontologique Internationale have put all students of fossil man deeply in their debt by providing the essential data concerning site, discoverer, type of industry, principal associated fauna, geology and archeology, character of the remains, repository, casts available, and bibliography. Illustrations have been omitted for the simple reason that they would disproportionately have increased the cost of a volume which without them is easily within the reach of any student desiring a copy.

It is very much to be hoped that this excellently produced and useful work will have a long life, and that from time to time new editions of it will appear.

Copies of the work may be obtained at the price of 500 francs from: Secrétariat Général, XIX Congrès Géologique International, Faculté des Sciences, Alger, French North Africa.

Ashley Montagu

*An Rh-Hr Syllabus.* By A. S. WIENER, xii + 82 pp. Grune & Stratton, New York, 1954, $3.75.

Time was when a non-specialist, with an ordinary amount of application, could keep abreast of the work in blood grouping and typing. But progress in this branch of serology has of late years been so rapid that it has become virtually a full-time job to keep up with the new discoveries and the increasing complexity of the subject.

In the present volume, Wiener sets out to put the inexpert reader at his ease with the Rh-Hr types. His object of presenting a compact, readable, up-to-date summary of the subject is accomplished by presenting the information in the form of a glossary, arranged in logical rather than alphabetical order.

Following an account of the fundamentals of the subject, the author proceeds to a discussion of the Rh antibodies, the serology and genetics of the Rh-Hr types, erythroblastosis fetalis, blood transfusion, and autosensitization. He also discusses the anthropological and medico-legal aspects of the subject, and there is a useful index.

Wiener's discussion and criticism of the Fisher symbols for Rh phenotypes, his classification of ethnic groups, and his suggested explanations of the mechanisms involved in various obscure hemolytic conditions add to the interest as well as the value of this little volume.

The clarity of the diagrams and the tables combine to ease the reader's path. The volume would benefit from the dropping of a few solecisms in a future edition.

ASHLEY MONTAGU

*Clinical Genetics.* Edited by ARNOLD SORSBY, xi + 580 pp. C. V. Mosby Co., St. Louis, Missouri, 1953, $17.50.

This volume constitutes a substantive contribution to clinical pathology from the standpoint of genetics. It is a book which all human biologists will at some time wish to consult. Altogether there are 29 contributions by 26 contributors. The book is divided into two sections. (I) Theoretical Considerations, and (II) Clinical. An elementary knowledge of genetics is assumed throughout.

Sorsby opens with a discussion of "Clinical varieties of disease," which is admirable for its balance, its emphasis on heredity as the interaction between genotype and environment, and its extremely valu-

able " tentative classification of the clinical varieties of genetic disease." Snyder and David follow with by far the best discussion of " Penetrance and expression " that we have. Here these authors also enter upon a valuable account of modifying environmental factors, and a discussion of the constitutional approach, which make an admirable supplement to Sorsby's article and a good introduction to those which follow. Neel's " The detection of genetic carriers of inherited disease," offers both an able discussion and a useful table of the carrier states of 33 diseases and their probable mode of inheritance. Waterhouse summarizes " Twin studies " in a paper which is a model of its kind. Ford's discussion of " Sex limitation " represents an important contribution toward the clarification of a too often confusedly discussed subject. Mather's " Polygenic inheritance " is a magisterial piece, treating of a highly complex subject, the statistical genetics of continuous variation, with consummate ease and clarity. Macgregor provides a crystal-clear " Evaluation of linkage," which is at once theoretically enlightening and practically helpful. Crew's informative chapter on " Mutation " contains a section on " Medical and social aspects of mutation " which is of the first order of importance and should be required reading by all human biologists. Dahlberg's exposition of the " Biometric evaluation of findings " is almost certainly the best short piece of its kind; indeed, it is a masterpiece. Koller's admirable account of " Cytogenetics " contains a grave warning which reenforces the comments of Crew. In discussing the potential dangers of radiotherapy and chemotherapy, Koller urges the greatest caution and continuous investigation, for, as he says, " Gene mutations are almost always deleterious and if they are produced with high frequencies, they will, throughout future generations, kill more people whose germ plasm is contaminated with the mutated genes than could be killed directly by the explosion of the atom bomb " (p. 119). Catcheside is quite exciting on " Chemical genetics." With a section on " Comparative pathology " Sorsby concludes the first part of the volume.

Part II opens with a discussion by Tanner of the " Inheritance of morphological and physiological traits." D. Klein presents an able analysis of " Metabolic disorders," and O. L. Scott deals with " Diseases of the skin "—the largest and physiologically least studied of the organs of the human body. In an admirable article Falls deals with the " Skeletal system, including joints." Stephens on " Muscular disorders " is excellent. Pratt on " Diseases of the nervous system " deals most ably with a difficult subject, and Böök on " Oligophrenia " (mental deficiency)

is both informative and well-balanced. Slater on "Psychiatry" is exemplary. Every psychiatrist would benefit greatly from a reading of this remarkable paper. His discussion of the strengths and weaknesses of psychiatric genetics should be read by all human biologists. Somewhat surprisingly Slater rather uncritically accepts the work of Sheldon on constitution and temperament—which Hanhart, many pages later in the same book, does not. Sorsby's account of genetic disorders of the eye is most enlightening, and two pedigrees are given of what appear to be mutations. Lindenov discusses the genetics of disorders of "The ear," and Rushton writes on "The teeth." Here it could have been wished that the coverage had been a little fuller. Rushton unaccountably omits many of the fundamental references to the literature. Carter on the "Alimentary system" is most interesting, but one could wish that he had discussed the embryogenetics of cleft-palate and hare lip somewhat more in detail. Lindenov discusses the "Respiratory organs" and Herndon the "Cardiovascular system." Neel ably covers the field of "Inherited abnormalities of the cellular constitutents of the blood," and Jackson briefly but adequately sets out the facts about "The haemorrhagic diatheses"—mainly hemophilia. Stratton's account under "Serology," of the blood groups and types is exemplary. Tage Kemp on "The urogenital system" and Bartels on "Endocrine disorders" are most informative, and so is Hanhart on "Infections diseases" and Schwartz on "Allergy." Gorer concludes the book with a splendid chapter on "Cancer."

There is a good selected bibliography and an index.

Altogether this is a notable contribution surveying our knowledge of clinical genetics to date.

ASHLEY MONTAGU

# BOOKS RECEIVED

THE ATOM STORY. By J. G. Feinberg. 243 pp. Philosophical Library, New York. 1953. $4.75.

ADJUSTMENT TO PHYSICAL HANDICAP AND ILLNESS: A SURVEY OF THE SOCIAL PSYCHOLOGY OF PHYSIQUE AND DISABILITY. By Roger G. Barker. xvi + 440 pp. Social Science Research Council, New York. 1953. $2.00.

VARIATIONS IN HUMAN BODY-BUILD, a Somatometric and X-Ray cephalometric Investigation on Scandinavian Adults. By Bengt Lindegard. 163 pp. Berlingska Boktryckeriet, Lund, Sweden. 1953.

SYMPOSIUM ON FATIGUE. Edited by W. F. Floyd and A. T. Welford. viii + 196 pp. H. K. Lewis and Co., Ltd., London, 1953. $4.00.

THE MEANING OF SOCIAL MEDICINE. By Iago Galdston. viii + 137 pp. Harvard University Press, Cambridge, Massachusetts. 1954. $2.75.

FIFTY YEARS OF MEDICINE. By Lord Horder. 70 pp. Philosophical Library, New York. 1954. $2.50.

THE FIRST AUSTRALIANS. By Ronald M. Berndt and Catherine H. Berndt. 144 pp. Philosophical Library, New York. 1954. $4.75.

A DEVOTION TO NUTRITION. By Frederick Hoelzel. 88 pp. Vantage Press, Inc., New York. 1954. $2.50.

THE HUMAN ANIMAL. By Weston LaBarre. xv + 372 pp. The University of Chicago Press, Chicago, Illinois. 1954. $6.00.

SYMPOSIUM ON HUMAN FACTORS IN EQUIPMENT DESIGN. Edited by W. F. Floyd and A. T. Welford. viii + 132 pp. H. K. Lewis and Co., Ltd., London. 1954. $4.00.

A METHODOLOGICAL, PSYCHIATRIC AND STATISTICAL STUDY OF A LARGE SWEDISH RURAL POPULATION. By Tage Larsson and Torsten Sjögren. 250 pp. Acta psychiat. neurol. Scandinav., Supplementum 89, Copenhagen. 1954.

BEYOND THE GERM THEORY. By Iago Galdston. viii + 182 pp. Health Education Council, New York. 1954. $4.00.

PSYCHOMOTOR ASPECTS OF MENTAL DISEASE. By H. E. King. xiv + 185 pp. Harvard University Press, Cambridge, Massachusetts. 1954. $3.50.

THE RACIAL AFFINITIES OF THE BAGANDA AND OTHER BANTU TRIBES OF BRITISH EAST AFRICA. By Lawrence Oschinsky. x + 188 pp. W. Heffer and Sons, Ltd., Cambridge, England. 1954. 25 S.

THE DEAF AND THEIR PROBLEMS. By Kenneth W. Hodgson. xx + 364 pp. Philosophical Library, New York. 1954. $6.00.

CHILD PSYCHOLOGY. By Arthur T. Jersild. xii + 676 pp. Prentice Hall, New York. 4th ed., 1954. $8.00.

SOCIAL SCIENCE IN MEDICINE. By Leo W. Simmons and Harold G. Wolff. 254 pp. Russell Sage Foundation, New York. 1954. $3.50.

SYMPOSIUM ON PROBLEMS OF GERONTOLOGY. Edited by Robert S. Goodhart. ii + 141 pp. Nutrition Symposium Series, Number 9, National Vitamin Foundation, Inc., New York. 1954. $2.50.

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## INFORMATION FOR CONTRIBUTORS

HUMAN BIOLOGY, a record of research, is a quarterly journal devoted to the subject its name implies. It publishes original articles dealing with human genetics, development, growth, reproduction and aging, functional anatomy, bio-anthropology, human ecology, population dynamics, etc.

The original manuscripts, typed double-spaced on one side of 8½ x 11 inch paper in complete and finished form precisely as they are to appear, should be sent—packed flat—to the editor, Dr. Gabriel Lasker, Wayne University College of Medicine, 1401 Rivard Street, Detroit 7, Michigan. It is desirable that a second copy be included in order to expedite prompt consideration, and that an additional carbon copy and copies of all illustrations should be retained by the author.

Where possible, illustrations should be made for reproduction as line engravings, hence drawn in India ink as bold as possible. Lettering must remain legible after figures are reduced to fit on 4½ x 6¾ inch pages (letters 1½ to 2 mm high after reduction are adequate). Figures should be numbered consecutively with Arabic numerals. Tables should be numbered independently from 1 up, and both figures and tables should have captions. When the amount of tabular and illustrative material is judged to be excessive or unusually expensive, authors may be requested to pay the excess cost. Galley proofs will be sent to the author and must be returned promptly; when the author makes substantial departures from copy, the cost will be charged to him. Three copies of an abstract (not to exceed 225 words) should be submitted when the proof is returned. One will be sent to the editor of *Biological Abstracts*.

References in the text to the literature should be made by using the author's name followed by the year of publication: "Studies of Garn and Saalberg ('53) . . ." At the end of the article, under the heading "LITERATURE CITED," full references with titles and inclusive page references should appear (double spaced) in alphabetical order of the authors' names: "GARN, S. M. AND J. H. SAALBERG 1953 Sex and age differences in the composition of the adult leg. Human Biol., 25: 144-153."

Authors will receive 25 free reprints. Orders for additional reprints should be placed at the time proof is returned. It will not be possible to accept orders for reprints after the proof has been returned to the press.

# Human Biology

## a record of research

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WAYNE UNIVERSITY PRESS, *Publishers*

DETROIT 1, MICHIGAN U. S. A.